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AUTHOR Romberg, Thomas A.; Glove, Pichard

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### ABSTRACT

The purpose of this study was to determine whether a process model could be constructed using steps identified from flow charts which accounted for somewhat more variance in predicting the difficulty of two-digit multiplication problems than did a process model developed by Cromer. Cromer's data and variables were used as a starting point. Ten new variables were identified from multiplication and addition flow charts. Seven basic models, 4 reduced models, 10 factor models, 24 one-variable models, and a set of systematic restricted models were examined. Multiple regression analysis was used to predict difficulty. The overall results indicate that the flow chart variables do produce somewhat better models. This volume presents the first of two parts of this report and includes the problem statement and results. (Author/SD)

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TECHNICAL REPORT NO. 337 (PART 1 OF 2 PARTS)

process models for predicting the difficulty of multiplication problems using flow charts



WISCONSIN RESEARCH AND DEVELOPMENT CENTER FOR COGNITIVE LEARNING

Technical Report No. 337 (Part 1 of 2 Parts)

PROCESS MODELS FOR PREDICTING THE DIFFICULTY OF MULTIPLICATION PROBLEMS USING FLOW CHARTS

by

Thomas A. Romberg Richard Glove

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Report from the Project on Conditions of School Learning and Instructional Strategies

Thomas A. Romberg
Principal Investigator

Wisconsin Research and Development Center for Cognitive Learning The University of Wisconsin Madison, Wisconsin

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### **ABSTRACT**

The purpose of this study was to determine whether a process model could be constructed using steps identified from flow charts which accounted for somewhat more variance in predicting the difficulty of two-digit multiplication problems than did a process model developed by Cromer (1971). Cromer's data and variables were used as a starting point. Ten new variables were identified from multiplication and addition flow charts. Seven basic models, 4 reduced models, 10 factor models, 24 one-variable models, and a set of systematic restricted models were examined. Multiple regression analysis was used to predict difficulty. The overall results indicate that the flow chart variables do produce somewhat better models.

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### THE PROBLEM AND MODELS

### INTRODUCTION

While endeavoring to build an adequate theory of mathematics learning, some mathematics educators have attempted to construct and refine theoretical models of mathematics learning confined to specific areas of mathematics. One type of model that has been studied is the process model for the learning of an arithmetic skill.

The purpose of this study was to refine such a model. More work on models needs to be done in order to construct a reasonable theory of mathematics learning which will help teachers to give better instruction to their students in all areas of mathematics.

### VARIABLES

Fred Cromer (1971) constructed a model for predicting the difficulty of two-digit by two-digit multiplication problems. In his model, Cromer considered problems of the form

ab xcd

where a, b, c, and d are digits, with a and c representing the tens digits and b and d the units digits. Any of a, b, c, or d could be equal to 0. If c = 0, the problem was written

ab x d

If a = 0 and c = 0, the problem was written

д <u>х d</u>

No problems of the form

b xcd

were considered, since the students had not had exposure to this type of problem. In attempting to predict the difficulties of these problems, Cromer used 14 variables.



1

ORD--the order of the problem as presented on the test TDF--the value of the tens digit of the first number UDF--the value of the units digit of the first number TDS--the value of the tens digit of the second number UDS--the value of the units digit of the second number OA--the number of operation steps in addition

OA was defined as follows:

$$OA(a + b) = \begin{cases} 0 \text{ if } a = 0 \text{ or } b = 0 \\ 1 \text{ otherwise} \end{cases}$$

$$OA(ab + d) = \begin{cases} OA(b + d) \text{ if } b + d \le 9 \\ OA(b + d) + 1 \text{ if } b + d > 9 \end{cases}$$

$$OA(ab + cd) = \begin{cases} OA(b + d) + 1 \text{ if } b + d \le 9 \\ OA(b + d) + 2 \text{ if } b + d > 9 \end{cases}$$

$$OA(abc + def) = OA(a + d) + OA(bc + ef) + K$$

$$where K = \begin{cases} O \text{ if } bc + ef \le 99 \\ 1 \text{ if } bc + ef > 99 \end{cases}$$

OA(abcd + efgh) = OA(a + e) + OA(bcd + fgh) + K  
where 
$$K = \begin{cases}
0 & \text{if bcd} + \text{fgh} \leq 999 \\
1 & \text{if bcd} + \text{fgh} > 999
\end{cases}$$

OM--the number of operation steps in multiplication OM was defined as follows:

OM(a x b) = 
$$\begin{cases} 0 & \text{if a or b equals 0 or 1} \\ 1 & \text{otherwise} \end{cases}$$

OM(ab x c) = OM(a x b) + OM(b x c) + K

where 
$$K = \begin{cases} 0 & \text{if } b \times c \leq 9 \\ 1 & \text{if } b \times c > 9 \end{cases}$$

 $OM(ab \times cd) = OM(ab \times c) + OM(ab \times d)$ 



DCA--the number of digits carried in addition
DCA was defined as follows:

DCA (abcd + efgh) = 
$$K_1 + K_2 + K_3$$
  
where
$$K_1 = \begin{cases} 0 & \text{if } d + h \le 9 \\ 1 & \text{if } d + h > 9 \end{cases}$$

$$K_2 = \begin{cases} 0 & \text{if } cd + gh \le 99 \\ 1 & \text{if } cd + gh > 99 \end{cases}$$

$$K_3 = \begin{cases} 0 & \text{if } bcd + fgh \le 999 \\ 1 & \text{if } bcd + fgh > 999 \end{cases}$$

DCM--the number of digits carried in multiplication DCM was defined as follows:

$$DCM(ab \times cd) = \begin{cases} 0 \text{ if } b \times d \leq 9 \text{ and } b \times c \leq 9, \\ 1 \text{ if } b \times d > 9 \text{ or } b \times c > 9 \text{ but not both} \\ 2 \text{ if } b \times d > 9 \text{ and } b \times c > 9 \end{cases}$$

LDF--the largest digit in the factors SDF--the smallest digit in the factors

SDF--the smallest digit in the lactors

NDP--the number of digits in the product

SMD--a variable to indicate whether the units and tens digits of either of the factors were the same

SMD(ab x cd) = 
$$\begin{cases} 0 \text{ if a } \neq \text{ b and c } \neq \text{ d} \\ 1 \text{ if a = b or c = d} \end{cases}$$

LFS--a variable to indicate whether the second factor was larger than the first factor

LFS(ab x cd) = 
$$\begin{cases} 0 & \text{if ab < cd} \\ 1 & \text{if ab } \ge \text{cd} \end{cases}$$

As the dependent variable, Cromer used a variable for the general problem difficulty (DIFF). He determined the value for this variable by administering two forms of an 84-problem multiplication test to 238 fifth-grade students. The problems were determined by using a random number routine. DIFF was defined to be the proportion of the students who failed to arrive at the correct solution. Thus, the lower the value of DIFF, the less difficult the problem was. The range of DIFF could be 0 to 1.



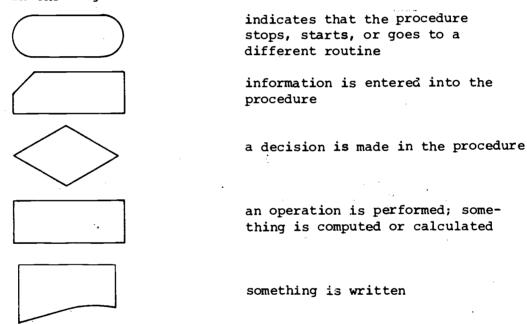
The purpose of this study was to consider several variations of Cromer's model that could be achieved by replacing some of his variables with other variables in the hope of arriving at a better prediction model. Thus, using Cromer's data as a basis, new models were constructed. Cromer's variables OM and OA failed to differentiate adequately between different types of problems. For example, the

42	40	61	82	15
<b>x</b> 2	<b>x</b> 34	x55	<u>x41</u>	<u>x20</u>

following problems all have OM = 2, using Cromer's definition:

A flow chart description of algorithms by Romberg and Anglin (1973) appeared to differentiate between more different classes of problems. The flow chart indicating the various steps that were involved in completing the multiplication part of a multiplication problem is shown in Figure 1.

In the diagram:



Because the different types of steps may differentially influence difficulty, it was decided to count the number of decisions made, the number of calculations done, and the number of writing operations involved in each problem, as well as the number of total steps needed to complete the routine. Therefore, the following variables were considered:

NDM--the number of decisions that an individual would have to make when going through the multiplication routine

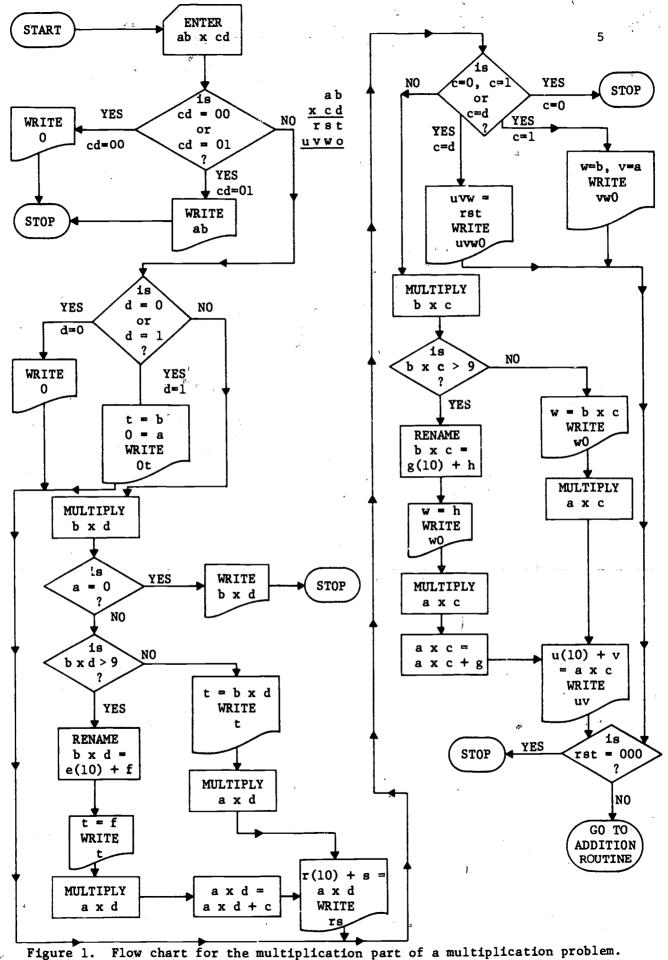
YDM--the number of those decisions to which the answer <u>yes</u> was given

NOM--the number of operational steps that were involved in the multiplication routine

NWM--the number of writing steps in the multiplication routine

TSM--the total number of steps in the multiplication routine





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So, for the problems indicated above, where Cromer's variable OM = 2, the values for these new variables are:

	42 x 2	40 <u>x34</u>	61 <u>×55</u>	82 <u>x41</u>	15 <b>x2</b> 0
NDM =	5	7	6	. 5	5
YDM =	1	. 0	1	1	3
NOM =	2	4	2	2	4
NWM =	. 2	** ******* <b>4</b>	3	3	3
TSM =	9	15	11	10	12

It should be noted that NDM + NOM + TSM. The other types of steps involved in the routine were not considered, since their values would not have differed for the problems considered and since the problems were already printed for the student to read and use.

Similarly, a flow chart was constructed for the addition part of a multiplication problem (see Figure 2). The following variables were defined for the addition routine.

NDA--the number of decisions that an individual would have to make when going through the addition routine

YDA--the number of those decisions to which the answer <u>yes</u> was given

NOA--the number of operational steps that were involved in the addition routine

NWA--the number of writing steps in the addition routine TSA--the total number of steps in the addition routine

Here also, NDA + NOA + NWA = TSA.

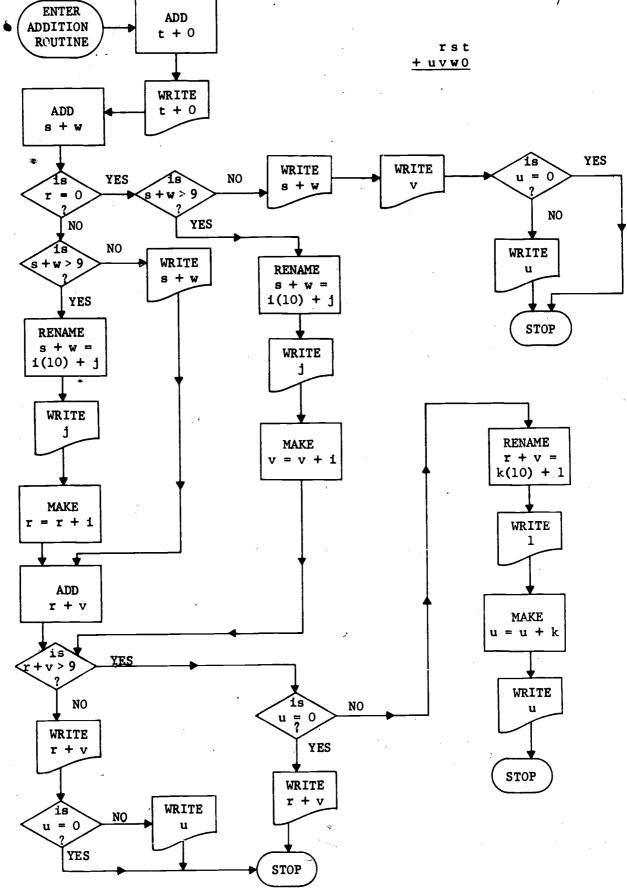
The values of these 10 new variables and the values of Cromer's 15 variables for all 168 problems are given in Table 58 in Appendix A.

### **MODELS**

Since a slightly different statistical package was available on the Univac 1110 at the University of Wisconsin-Madison from the one Cromer used, his original models were also re-evaluated so that comparisons could be made using the same procedure. The REGAN 2 program for multiple linear regression analysis (1971) was used to evaluate the models. The models examined fit into five categories: basic models, reduced models, factor models, one-variable models, and restricted models.







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Figure 2. Addition flow chart.

### Basic Models

Model 1 (the complete Cromer model) consists of all of Cromer's
14 variables used as predictors.

DIFF = 
$$A_0 + A_1$$
 ORD +  $A_2$  · TDF +  $A_3$  · UDF +  $A_4$  · TDS +  $A_5$  · UDS +  $A_{16}$  · OA +  $A_{17}$  · OM +  $A_{18}$  · DCA +  $A_{19}$  · DCM +  $A_{20}$  · LDF +  $A_{21}$  · SDF +  $A_{22}$  · NDP +  $A_{23}$  · SMD +  $A_{24}$  · LFS +  $E_1$  (1)

 ${\bf E_1}$  is the error in the model and the  ${\bf A_i}s$  were to be determined by the multiple regression procedure  ${\bf e}^{\circ}$ 

Model 2 (the Cromer digit model) was constructed using the 4 Cromer digit variables (TDF, UDF, TDS, and UDS) to see how it compared with Model 1.

DIFF =  $A_0 + A_2 \cdot TDF + A_3 \cdot UDF + A_4 \cdot TDS + A_5 \cdot UDS + E_2$  where  $E_2$  is the error in the model.

 $\frac{\text{Model 3}}{\text{OM, DCA, DCM, LDF, SDF, NDP, SMD, and LFS)}}$  and was also compared with Model 1.

DIFF = 
$$A_0 + A_{16} \cdot OA + A_{17} \cdot OM + A_{18} \cdot DCA + A_{19} \cdot DCM +$$

$$A_{20} \cdot LDF + A_{21} \cdot SDF + A_{22} \cdot NDP + A_{23} \cdot SMD + A_{24} \cdot$$

$$LFS + E_3 \tag{3}$$

 $\underline{\text{Model 4}}$  (the flow chart complete model) was constructed using the 10 new variables along with the 14 Cromer variables except OA and OM. This model was then compared with Model 1 to see if it accounted for more of the variance in the difficulty level.

DIFF = 
$$A_0 + A_1 \cdot ORD + A_2 \cdot TDF + A_3 \cdot UDF + A_4 \cdot TDS + A_5 \cdot UDS + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + A_{18} \cdot DCS + A_{19} \cdot DCM + A_{20} \cdot LDF + A_{21} \cdot SDF + A_{22} \cdot NDP + A_{23} \cdot SMD + A_{24} \cdot LFS + E_4$$
 (4)



Model 5 (the flow chart--process model) used the 10 new variables with the 9 Cromer process variables except OA and OM. This model was compared with Models 1, 3, and 4.

DIFF = 
$$A_0 + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + A_{18} \cdot DCA + A_{19} \cdot DCM + A_{20} \cdot LDF + A_{21} \cdot SDF + A_{22} \cdot NDP + A_{23} \cdot SMD + A_{24} \cdot LFS + E_5$$
 (5)

Model 6 (the flow chart only model) was designed to see how much of the variance was accounted for by the 10 new factors. It was then compared with Models 1, 3, 4, and 5.

DIFF = 
$$A_0 + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + E_6$$
(6)

Model 7 (the flow chart--digit model) used the 10 new variables along with Cromer's 4 digit variables. It was compared with Models 1, 4, and 6.

DIFF = 
$$A_0 + A_2 \cdot TDF + A_3 \cdot UDF + A_4 \cdot TDS + A_5 \cdot UDS + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + E_7$$
(7)

### Reduced Models

Since the number of steps of each type involved in both the multiplication and addition routines is partly determined by the number of digits carried in multiplication (DCM) and addition (DCA), it was decided to consider 2 models that deleted the two variables DCM and DCA.

Model 8 (reduced Model 5) was constructed using the 10 new variables and the Cromer process variables except OA, OM, DCA, and DCM. This model was compared with Models 3, 5, and 6.

DIFF = 
$$A_0 + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + A_{20} \cdot LDF + A_{21} \cdot SDF + A_{22} \cdot NDP + A_{23} \cdot SMD + A_{24} \cdot LFS + E_8$$
(8)



ريث الله

Model 9 (reduced Model 4) used the 10 new variables, the 4 Cromer digit variables and the Cromer process variables except OA, OM, DCA, and DCM. This model was compared with Models 1, 4, 7, and 8.

DIFF = 
$$A_0 + A_2 \cdot TDF + A_3 \cdot UDF + A_4 \cdot TDS + A_5 \cdot UDS + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + A_{20} \cdot LDF + A_{21} \cdot SDF + A_{22} \cdot NDP + A_{23} \cdot SMD + A_{24} \cdot LFS + E_9$$
(9)

Also, Cromer included the variable SMD, which equals 1 if the tens digit and the units digit of either of the factors are equal. Otherwise, the value of SMD equals 0. It would be expected that this factor would correlate negatively with the difficulty (in Cromer's study it does, in fact). However, the only case in which the digits' being the same would be an important consideration is when the units and the tens digits of the second factor are the same, thus allowing the student to only actually do one multiplication. In the case where the units and tens digits of the first factor are the same, it would not affect the problem so much. Since the multiplication routine considers this possibility, it was decided to construct two additional models deleting SMD.

Model 10 (reduced process model) was constructed using the 10 new variables and the Cromer process variables LDF, SDF, NDP, and LFS. This model was compared with Models 3, 5, 6, and 8.

DIFF = 
$$A_0 + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + A_{20} \cdot LDF + A_{21} \cdot SDF + A_{22} \cdot NDP + A_{24} \cdot LFS + E_{10}$$
(10)

Model 11 (reduced complete model) used the 10 new variables
Cromer's digit variables, and the Cromer process variables LDF, SDF,
NDP, and LFS. This model was then compared with Models 1, 4, 7, 9, and 10.

DIFF = 
$$A_0 + A_2 \cdot TDF + A_3 \cdot UDF + A_4 \cdot TDS + A_5 \cdot UDS + A_6 \cdot NDM + A_7 \cdot YDM + A_8 \cdot NOM + A_9 \cdot NWM + A_{10} \cdot TSM + A_{11} \cdot NDA + A_{12} \cdot YDA + A_{13} \cdot NOA + A_{14} \cdot NWA + A_{15} \cdot TSA + A_{20} \cdot LDF + A_{21} \cdot SDF + A_{22} \cdot NDP + A_{24} \cdot LFS + E_{11}$$
(11)



### Factor Analytic Models

Since there is considerable correlation between the 24 variables, it was decided to perform a factor analysis, as Cromer had done, of the variables used in all 11 of the models except Model 2. Cromer had used a principle axis factor analysis with promax rotations. The promax rotations yielded oblique factors. These procedures were not available on the Univac 1110 at the University of Wisconsin-Madison, and so a principle factor analysis with verimax rotations was used. Since NDM, NOM, NWM, and TSM are linearly dependent, as are NDA, NOA, NWA, and TSA, and since the principle factor analysis method available could not handle such a situation, TSM and TSA were removed before the factor analysis was performed. The verimax rotations yielded orthogonal factors, and so the results are not comparable with those of Cromer, and in some cases different factors are extracted. The digit variables in Model 2 were not factored, since the numbers were chosen randomly and, therefore, four orthogonal factors could be expected.

### One-Variable Models

Since there were 24 predictor variables (Cromer's 14 together with 10 new ones), 24 models consisting of one variable each were considered in order to test the amount of the variation that each variable accounted for.

DIFF = 
$$A_0 + A_i \cdot W_i + E_{13 + i}$$
  
where  $W_i$  = the ith of the 24 possible predictor variables
$$E_{13 + i} = \text{the error of the model}$$

### Restricted Models

Next, for each of Models 1-11, systematic restricted models were considered by eliminating one variable from consideration at a time and then replacing that variable and removing the next. This process was continued until all variables had been removed once. This was done to test the independent contribution of each variable.

After the factors were extracted, the variable correlating most highly with that factor was used to construct a new model. Models IF and 3F-11F, parallel to Models 1 and 3-11, were then constructed and compared with the fast models to see if they accounted for approximately the same amount of the variance. Only factors accounting for more than 1 percent of the total factor variance were included in the analysis. The factors which Cromer extracted from Models 1 and 3 were different from the factors obtained in this study, and therefore two additional models, 1FC and 3FC, were constructed using the factors that he had obtained.



### **RESULTS**

In first analyzing the variables for each of the 168 multiplication problems, a correlation matrix was constructed. This matrix was used, with the twenty-fifth row deleted and certain other rows and columns deleted, to perform the factor analysis. The correlation matrix is found in Table 1. All of the variables except ORD and SMD correlated significantly with DIFF. The highest correlation with DIFF was TSM, which accounted for 53 percent of the variance, and the lowest after ORD and SMD was LFS, which accounted for 3 percent. The 10 new variables accounted for a significant part of the variance, with the lowest being YDM and YDA, which accounted for 7.8 percent and 13.2 percent of the variance, respectively.

In this section, the data for the 11 models along with the models derived from the factor analysis are reported. Also, comparisons are made with similar models to note any differences. Data for the one-variable models are summarized.

Model 1. This complete Cromer model produced an  $R^2$  value of .7763 and a corrected  $R^2$  of .7558. The data for Model 1 are presented in Table 2.

When the factor analysis was performed on the variables in Model 1 (13 process and digit variables), 8 factors were extracted. The eighth factor was not considered, since it only accounted for .1 percent of the total factor variance. Table 3 indicates the percentage of the total factor variance and the percentage of the total variance accounted for.

Table 4 presents the rotated factor matrix. Using this table, the variables that correlated most highly with each factor were chosen to represent that factor in the factor model. The variables used were DCM, TDS, DCA, TDF, UDS, LDF, and SMD. The Model 1F generated by the use of these 7 factors is presented in Table 5. This model yielded an  $R^2$  of .7053 and a corrected  $R^2$  of .6924. Since Cromer's factoring procedures yielded oblique factors, the factors that he extracted were somewhat different. Using only 4 factors and the variables DCM, TDS, OA, and TDF to represent them, the model yielded an  $R^2$  of .6572 and a corrected  $R^2$  of .6487. The summary of Model 1FC is presented in Table 6.

In both cases, the models generated from the factors extracted by the factor analysis accounted for less of the variance than did the full model. A summary of the differences in the  $\mathbb{R}^2$  for the three models appears in Table 7.

Summaries of the restricted models produced from each of the preceding models are presented in Tables 59, 60, and 61 in Appendix B.



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TABLE 1

### CORRELATION MATRIX 25 FLOW CHART--CROMER VARIABLES

ORD 1 TDF UDF TDS - UDS NDM NOM NOM NOM NOM NOM TSA - OA OA OA LDF SDF SDF SDF NOA I LFS OA OA OCA CA C		ORD	TDF	UDF.	TDS	san	WDW	, XDM	NOM	NWIN	TSM	NDA	
TUPE (1010   1,000)  TUPE (101	1 ORD	1.000							-				
U.S.   C.   C.   C.   C.   C.   C.   C.	2 TDF	.010	1.000	***									
TUS        099        103         .100         .100           NEM         .099        1036         .000         1.000         .100         .100           NEM         .099        1036         .022         .031         .000         .469         .561         .100         .100           NEM         .039        034         .003         .413         .403         .522         .031         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .103         .000         .100	3 UDF	.040	055	1.000									
UDS         0.99        036        032         .031         1.000           NEM         0.99        036        022         .031         1.000           NEM         0.09        031         .034         .056         .012         .030         .012         .030           NOA         .044         .053         .444         .053         .045         .013         .040         .013         .000<	4 TDS	003	.109	.001	1.000			• •					
NEW   0.037   0.081   0.001   4.66   1.561   1.000	son s	660.	036	022	.031	1.000							
YOAR         1040         1.23         624         -125         -101         1000           YOAR         1048         -153         624         -125         -101         1000           YSAR         1044         055         -415         -104         -104         105         -104         105         -104         105         -104         105         -104         105         -104         105         -104         105         -104         105         -104         105         -104         105         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104         -104         100         -104         -104         100         -104         -104         100         -104         -104         100         -104         100         -104         100         -104         100         -104         100         -104         100         -104 <t< td=""><td>e NDM</td><td>.037</td><td>.081</td><td>.001</td><td>.469</td><td>.561</td><td>1.000</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	e NDM	.037	.081	.001	.469	.561	1.000						
No.   O.   O.   O.   O.   O.   O.   O.	7 YDM	800.	123	.624	.023	125	010	1,000					
NRM         0.01         0.98         0.07         -6.66         -424         -919         0.007         -821         1.000           NDA         -0.048         0.074         2.66         -426         -426         -0.03         -961         -910         -920           NDA         -0.048         0.074         0.056         -136         <	WOM: 8	.044	.055	.415	.413	.470	.791	363	1.000				
Table   1.000   1.00	WWN 6	.013	860.	620.	909.	.424	.919	.007	.821	1.000			
NNA         - Odd         - 1045         - 175         - 058         - 554         - 436         - 136		.038	.074	.250	.490	.516	.925	. 203	.961	. 932	1.000		
NCM        034         .067         .135         .113         .222         .287         .026         .250         .360         .297           NCM        002         .286         .181         .135         .113         .222         .287         .020         .633         .741         .703           NWA        023         .215         .052         .628         .713        136         .655         .656         .655         .655         .656         .655         .656         .655         .656         .655         .656         .655         .656         .655         .656         .656         .655         .656         .655         .656         .655         .656         .655         .656         .655         .656         .655         .656         .656         .655         .656         .657         .713         .714         .713         .714         .714         .715         .716         .653         .717         .716         .653         .717         .716         .653         .717         .716         .653         .717         .716         .723         .724         .723         .724         .724         .724         .724         .724         .724         .724	11 NDA	045	.175	.058	.554	.436	.740	133	.611	.832	.728	1.000	
NRA         . 000         . 286         . 181         . 444         . 504         . 675         020         . 531         . 741         . 703           TSA         023         . 241         . 105         . 656         . 645         . 645         . 645         . 673         . 703           TSA         023         . 244         . 113         . 645         . 645         . 645         . 645         . 645         . 645         . 675         . 665         . 656         . 773         . 773         . 773         . 773         . 773         . 773         . 773         . 774         . 693         . 773         . 773         . 773         . 774         . 693         . 773         . 773         . 774         . 693         . 773         . 773         . 774         . 693         . 773         . 774         . 693         . 773         . 774         . 773 </td <td></td> <td>034</td> <td>.067</td> <td>.135</td> <td>.113</td> <td>. 222</td> <td>. 287</td> <td>.028</td> <td>.250</td> <td>360</td> <td>.297</td> <td>. 544</td> <td>-</td>		034	.067	.135	.113	. 222	. 287	.028	.250	360	.297	. 544	-
NRA         - 0.29         2.13         - 1.36         5.89         8.81         710           NSA         - 0.23         2.24         111         5.56         3.66         7.13         - 1.36         5.89         8.21         7.10           ON         - 0.23         2.64         111         5.56         4.64         7.73         - 0.92         6.65         6.69         6.65         6.65	13 NOA	000.	.286	.181	.444	504	.675	020	. 633	.741	. 703	.840	
TSA023244111556464738092645829746746002002666252358499614092665656652746002002002252358499614092665656652746002003002322328499614059417914713665656652771002003003203	14 NWA	029	.215	.052	.628	.366	.713	136	599	.821	.710	972	
OA         .028         .266         .252         .38         .499         .614         .054         .665         .656         .656         .652         .773         .773         .773         .773         .773         .774         .653         .774         .773         .774         .653         .774         .773         .774         .653         .774         .775         .774         .775         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .774         .7		023	. 244	.111	.556	464	. 738	092	. 645	829	.746	026	
ON        022         .138         .426         .433         .471         .712         .417         .914         .773         .867           DCA         .015         .326         .213         .439         .446         .059         .448         .452         .459           DCA         .013         .321         .329         .493         .471         .712         .417         .914         .773         .459         .459           DCA         .023         .124         .373         .270         .203         .619         .773         .738         .459         .773           SND         .023         .1039        1053         .277         .273         .273         .774         .693           SND         .021         .039        1053         .277         .778         .619         .703           SND         .022         .039        1063         .126         .123         .031         .277         .176         .693         .724           SND         .034         .100         .100         .100         .100         .211         .100         .110         .100           NA         .100         .100         .100		.028	. 266	. 252	.358	499	614	.054	- 605	. 656	.652	. 750	
DCA         .015         .036         .211         .219         .403         .416         .059         .438         .452         .459         .459         .459         .459         .459         .459         .459         .459         .459         .459         .459         .456         .660         .882         .459         .459         .456         .459         .459         .456         .459         .456         .459		022	.138	.426	. 433	471	217.	417	914	713	867	909	
DCM         .020         .013         .593         .325         .384         .546         .640         .882         .563         .771           LDF         .087         .364         .346         .373         .270         .543         .546         .546         .640         .882         .563         .771           NDF         .083         .284         .346         .373         .270         .573         .073         .553         .774         .693         .771           NDF         .028         .339        063         .277         .774         .698        098        098           NDF         .026        568        077         .554         .124        053         .001        112        098        098           DIFF         .077         .273         .474         .438         .271         .776         .696         .724           DIFF         .077         .178         .07		.015	306	211	219	403	416	<b>6</b> 50	438	452	459	905	
LDF   .087   .364   .346   .373   .270   .203   .061   .305   .322   .295   .295   .285   .295   .		.020	.013	. 593	.325	.384	546	640	882	563	177	463	
SDF        053         .229         .385         .493         .392         .573         .273         .728         .619         .703           SND         .028        339        003         .693         .271         .733         .070         .573         .774         .693           SND        028        033        063        073        054        128        273        774        693           LES        006        508        073        564        128        233        070        112        098        098           DEF        077        273        071        277        16        75        249        299        299        299        299        299        299        249        299        249        299        249        299        299        299        249        299        249        299        249        299        249        249        249        249        249        249        249        249        249        249        249        249        249 <td< td=""><td></td><td>.087</td><td>.364</td><td>.346</td><td>.373</td><td>.270</td><td>. 203</td><td>190</td><td>305</td><td>322</td><td>295</td><td>378</td><td></td></td<>		.087	.364	.346	.373	.270	. 203	190	305	322	295	378	
.028       .339      003       .693       .271       .733       .070       .573       .774       .693         .021       .039      063       .053       .148      053      001      112      098      098         .007       .223       .031       .203       .203       .305       .244         .077       .223       .455       .540       .189       .621       .277       .716       .696      098         .078       .100       .126       .126       .233       .001       .212       .244         .079       .100       .100       .00       .00       .00       .00       .01       .024       .024       .00       .024       .024       .024       .00       <		053	. 229	.385	.493	392	.573	. 273	728	619	703	625	
.021       .039      063       .053       .148      053      001      112      098      098        006      508      073       .564       .126       .233       .031       .203       .305       .244         1.006      508      073       .564       .126       .233       .031       .203       .305       .244         1.3       14       15       16       17       18       19       20       21       22         NOA       NWA       TSA       OA       OM       DCA       DCM       LDF       SDF       NDF         1.000       .819       1.000       .68       1.000       .68       1.000       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .69       .72       .79       .79       .70       .885       .501       1.000       .69       .74       .29       1.000       .69       .44       .373       .44       .373       .44       .374       .287       .79       1.000       .69       .69       .702       .79 </td <td></td> <td>.028</td> <td>.339</td> <td>003</td> <td>.693</td> <td>.271</td> <td>. 733</td> <td>070</td> <td>.573</td> <td>774</td> <td>663</td> <td>[69]</td> <td>. 265</td>		.028	.339	003	.693	.271	. 733	070	.573	774	663	[69]	. 265
006508073 .564 .126 .233 .031 .203 .305 .344 077 .223 .455 .540 .126 .233 .031 .203 .305 .244  1.00A NWA TSA OA OM DCA DCA DCM LDF SDF NDP  1.000 .819 1.000 .658 1.000  .941 .961 1.000 .658 1.000  .870 .478 .676 .885 .501 1.000  .533 .454 .512 .543 .930 .401 1.000  .694 .696 .698 .674 .817 .526 .734 .373 .370 .540 1.000  .918 .755 .717 .550 .612 .438 .431 .370 .540 1.000  .919 .700 .921 .920 1.000  .920 .920 1.000  .931 .932 .932 .934 .935 .936 .935 .935 .936 .935 .935 .935 .935 .935 .935 .935 .935		.021	.039	063	.053	.148	053	001	-,112	960 -	860	083	
13 14 15 16 17 18 19 20 21 22  NOA NMA TSA OA OM DCA DCA DCA DCM LDF SDF NDP  1.000  1		006	508	073	. 564	.126	. 233	.031	. 203	305	244	234	
13 14 15 16 17 18 19 20 21 22  NOA NAA TSA OA OM DCA DCM LDF SDF NDP  1.000  .819 1.000  .941 961 1.000  .945 .700 .853 1.000  .948 .676 .885 .501 1.000  .533 .454 .512 .543 .930 .401 1.000  .694 .640 .688 .674 .817 .526 .745 .299 1.000  .195 .079 .108 .106 .066 .160 .065 .166 .103  .114 .240 .196 .079 .173 .676 .612 .438 .431 .370 .540 1.000  .193 .079 .196 .107 .005 .161 .102 .612 .182 .182 .183 .166 .103  .193 .194 .297 .107 .297 .117 .550 .116 .065 .166 .167 .193		.077	.223	.455	.540	.389	.621	.277	.716	969.	.725	.640	
1.000 1.000		13	14	15	16	71	αl	٥٢	6	7,	33	23	
NOA         1.000         NOA         LOA         DCA         DCA         LDF         SDF         NDP           NWA         1.000         NWA         .819         1.000         .853         1.000         .853         1.000         .853         1.000         .853         1.000         .853         1.000         .853         1.000         .853         1.000         .853         1.000         .853         .850         .501         1.000         .853         .850         .501         1.000         .853         .850         .801         .801         .802         .803         .803         .401         .802         .803         .401         .802         .803         .803         .401         .803 <th< td=""><td>VARIABLE</td><td></td><td>1 11</td><td>C E</td><td>2 6</td><td>ì</td><td>9 6</td><td>1.5</td><td>07  </td><td>17</td><td>77</td><td><b>S</b></td><td></td></th<>	VARIABLE		1 11	C E	2 6	ì	9 6	1.5	07	17	77	<b>S</b>	
NOA         1.000           NWA         .819         1.000           A         .941         .961         1.000           OA         .945         .700         .853         1.000           OA         .945         .700         .853         1.000           OA         .945         .700         .853         1.000           OA         .945         .700         .885         .501         1.000           DCA         .870         .478         .573         .401         1.000           DCA         .874         .512         .543         .930         .401         1.000           DCA         .414         .373         .410         .428         .322         .374         .287         1.000           SDF         .694         .640         .688         .674         .817         .526         .745         .289         1.000           NDP         .631         .755         .717         .550         .612         .743         .743         .756         .702           SMD         .740         .196         .706         .182         .676         .676         .183         .676         .193		<b>V</b> ON	AMA	ISA	5	<b>E</b>	NCA TO	DCM	rDF.	SDF	NDP	CWS	
NWA         .819         1.000           TSA         .941         .961         1.000           OA         .945         .700         .853         1.000           OA         .945         .700         .853         1.000           OA         .945         .700         .658         .501         1.000           DCA         .870         .478         .501         1.000           DCM         .533         .454         .512         .543         .374         .287         1.000           DCM         .373         .414         .373         .410         .428         .322         .374         .287         1.000           SDF         .694         .640         .688         .674         .817         .526         .745         .299         1.000           NDP         .631         .755         .717         .550         .612         .438         .431         .370         .540         1.000           SMD         .135         .108         .166         .160         .042        013         .166         .002           LFF         .745         .576         .173         .275         .182         .502	13 NOA	1.000								r			
TSA .941 .961 1.000 OA .945 .700 .853 1.000 OM .668 .605 .660 .658 1.000  DCA .945 .700 .853 1.000  DCA .945 .700 .853 1.000  DCA .870 .478 .676 .885 .501 1.000  DCA .870 .478 .676 .885 .501 1.000  LDF .414 .373 .410 .428 .322 .374 .287 1.000  SDF .694 .640 .688 .674 .817 .526 .745 .299 1.000  SMD .631 .755 .717 .550 .612 .438 .431 .370 .540 1.000  SMD .135 .079 .108 .146 .066 .160 .042013 .166002  LFF .414 .240 .196 .079 .173025 .182 .650 .655 .156		.819	1.000		٠					****			
OA         .945         .700         .853         1.000           OM         .668         .605         .658         1.000           DCA         .870         .478         .676         .885         .501         1.000           DCA         .870         .478         .676         .885         .501         1.000           DCM         .533         .454         .512         .543         .930         .401         1.000           LDF         .414         .373         .410         .428         .322         .374         .287         1.000           SDF         .694         .640         .688         .674         .817         .526         .745         .299         1.000           NDP         .631         .755         .717         .550         .612         .438         .431         .370         .540         1.000           SMD         .135         .108         .166         .160         .042        013         .166         .103           LFF         .740         .196         .775         .782         .782         .782         .793           LFF         .745         .265         .166         .166		.941	.961	000.1						***.		•	
OM         .668         .605         .658         1.000           DCA         .870         .478         .676         .885         .501         1.000           DCM         .533         .454         .512         .543         .930         .401         1.000           DCM         .533         .454         .512         .543         .930         .401         1.000           LDF         .414         .373         .410         .428         .322         .374         .287         1.000           SDF         .694         .640         .688         .674         .817         .526         .745         .299         1.000           NDP         .631         .755         .717         .550         .612         .438         .431         .370         .540         1.000           SMD         .135         .108         .166         .160         .042        013         .166        002           LFF         .445         .676         .696         .166         .666         .160         .666         .160         .666         .160         .666         .160         .666         .160         .666         .160         .666         .1		. 945	.700	.853	1.000								
DCA         .870         .478         .676         .885         .501         1.000           DCM         .533         .454         .512         .543         .930         .401         1.000           LDF         .414         .373         .410         .428         .322         .374         .287         1.000           SDF         .694         .640         .688         .674         .817         .526         .745         .299         1.000           NDP         .631         .755         .717         .550         .612         .438         .431         .370         .540         1.000           SMD         .135         .079         .108         .146         .066         .160         .042        013         .166         .103           LFF         .43         .240         .196         .775         .182         .655         .193           LFF         .446         .676         .636         .515         .665         .162         .193		.668	.605	. 099	.658	1.000		ı				•	
DCM         .533         .454         .512         .543         .930         .401         1.000           LDF         .414         .373         .410         .428         .322         .374         .287         1.000           SDF         .654         .640         .688         .674         .817         .526         .745         .299         1.000           NDP         .631         .755         .717         .550         .612         .438         .431         .370         .540         1.000           SMD         .135         .079         .108         .146         .066         .160         .042        013         .166        002           LFS         .134         .240         .196         .775         .785         .576         .676         .182         .665         .193           DFF         .676         .636         .515         .566         .193         .793		.870	.478	. 929	.885	. 501	1.000						
LDF         .414         .373         .410         .428         .322         .374         .287         1.000           SDF         .694         .640         .688         .674         .817         .526         .745         .299         1.000           NDP         .631         .755         .717         .550         .612         .438         .431         .370         .540         1.000           SMD         .135         .079         .108         .146         .066         .160         .042        013         .166        002           LFS         .114         .240         .196         .079         .113        025         .182         .065         .156         .193           DIFF         .645         .645         .645         .646		.533	.454	.512	. 543	.930	.401	1.000					
SDF     .694     .640     .688     .674     .817     .526     .745     .299     1.000       NDP     .631     .755     .717     .550     .612     .438     .431     .370     .540     1.000       SMD     .135     .079     .146     .066     .160     .042    013     .166    002       LFS     .119     .079     .173    055     .182     .065     .156     .193       DIFF     675     645     645     645     645     645     645     645		.414	. 373	.410	.428	.322	.374	.287	1.000				
NDP         .631         .755         .717         .550         .612         .438         .431         .370         .540         1.000           SMD         .135         .079         .146         .066         .160         .042        013         .166        002           I.FS         .114         .240         .196         .079         .173        025         .182         .065         .156         .193           DIFF         .675         .645         .687         .776         .698         .515         .669         .669		.694	.640	. 688	.674	.817	.526	.745	. 299	1.000			
SMD .135 .079 .108 .146 .066 .160 .042013 .166002  LES .114 .240 .196 .079 .173025 .182 .065 .156 .193  DIFF 675 645 687 676 698 515 659		.631	.755	.717	.550	.612	.438	.431	.370	.540	1.000		
LFS .114 .240 .196 .079 .173025 .182 .065 .156 .193		.135	620.	.108	.146	990.	.160	.042	013	.166	002	1.000	
DIPP 675 645 687 676 609 515 650 550		.114	.240	961.	.079	.173	025	.182	. 065	.156	193	108	-
		.675	.645	.687	929	969	515	659	97.5	505	929	260	174



TABLE 2

### BASIC REGRESSION STATISTICS MODEL 1

	Sig. Level	!	.001	.5567	.2714	.0002	.0065	.0022	.0005	.0824	0080.	0090.	.1033	.1277	.0057	.0001	.9258
	Partial F Value with 1 and 153 Deg. Freedom		11.00498	.34690	1.21837	14.92304	7.60558	9.74060	12.46962	3.05772	3.10566	3.59077	2.68529	2.34572	7.87023	15,99410	. 00870
	T-Value with 153 Deg. Freedom		-3.31737	. 58898	1.10380	3.86304	2.75782	3.12099	3.53123	-1.74864	-1.76229	1.89493	1.63869	1.53157	2.80539	-3.99926	09326
Variables in the Equation	Partial Correlation Coefficient		259	. 048	680.	. 298	.218	.245	.275	-,140	141	.151	.131	.123	.221	308	008
Variables	Standardized Regression Coefficient		•	.0233	.0726	.2675	.2326	.1871	.3724	2864	1546	.2768	9960.	.1242	1202	- 1623	-,0064.
	Std. Error of Regression Coefficient		.0379422	6691000	.0026061	.0024531	.0029967	.0022338	0077889	.0082202	.0125634	.0183226	.0041703	0051477	13110	7028010	.0146420
	Regression Coefficient		- 1258684	1001000	.0028766	.0094763	.0082645	9126900	0275044	0143742	0221403	.0347200	0068338	0078841	0331459	0454540	0013654
	Type	denondent	Constant	independent	Tildependent	independent											
	Variable	25 PTEE		יים	1 6	301	A PURS	Sull 5	9 91	17 04	18 70	19 PCM	30.1.05	100	77 SQL 77	22 MUF	24 LFS

# ANALYSIS OF VARIANCE SUMMARY TABLE

	Source of Variation	Sum of Squares	Deg. Freedom	Mean Square
	Linear Regression Residuals from Regression	1.40818	14 153	.10058
Standard Error of Estimate		1.81407	167	
	F-Ratio = 37.92 with 14 and 153 Deg. Freedom Significance Level of F-Ratio = .0000	153 Deg. Freedom io = .0000	-	
Corrected Coefficient of Determination/558	Correction for Mean	6.74803 8 56210	1,168	

IJ.

TABLE 3

PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS
MODEL 1

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	28.0	20.9
2	21.0	15.7
3	17.5	13.1
4	13.1 ,	9.8
5	8.6	6.4
6	7.7	5.7
7	4.1	3.1



TABLE 4

ROTATED FACTOR MATRIX
MODEL 1

Var./	Factor	1	<b>2</b> _	3	4	5	6	7
1	TDF	014	. 205	.151	.787	024	.187	.056
2	UDF	.6 <b>79</b>	214	.122	059	239	369	.142
3	TDS	.151	<b>.8</b> 66	.089	159	087	.194	.101
4	UDS	.198	.024	.271	075	.679	.100	.187
5	OA	.347	.250	.773	.091	. 239	.167	.186
6	ОМ	.813	.367	.254	.042	.323	.008	.040
7	DCA	. 225	.126	.818	.154	.152	.152	.183
8	DCM	.911	.189	.171	076	<b>.19</b> 6	.073	.007
9	LDF	.167	.247	.207	.151	.124	.675	042
10	SDF	.670	.374	. 294	.099	.134	.062	.304
11	NDP	.231	.743	. 283	.177	.205	.061	<b>.0</b> 66
12	SMD	.008	.014	.090	024	.064	021	.368
13	LFS	.025	.445	035	719	.051	.06 <b>9</b>	.169

: # ...

TABLE 5

### BASIC REGRESSION STATISTICS MODEL 1F

				Variables	Variables in the Equation	a w		*
Variable	Type	Regression Ccefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 160 Deg. Freedom	Partial F Value with 1 and 160 Deg. Freedom	te 0 Sig. Level
25 DIFF	dependent							
	constant	055985	.024691	-	174	-2.26740	5.14111	.0247
19 DCM	independent	.049083	.006430	.3913	.517	7.63333	58.26778	0000.
-	independent	.010523	.001731	. 2962	.433	6.08001	36.96653	0000
	independent	.023777	.007665	.1661	. 238	3.10216	9.62340	.0023
2 TDF	independent	.002782	.001937	.0702	.113	1.43656	2.06371	.1528
-	independent	.005003	606100.	.1342	. 203	2.62042	99998.9	9600.
20 LDF	independent	.014848	.003742	.2099	. 299	3.96752	15.74118	:0001
	independent	046499	.01,1798	1736	297	-3.94143	15.53490	.0001
				. ,		e q fr	<b></b>	,
					ANALYSIS OF V	ANALYSIS OF VARIANCE SUMMARY TABLE	Y TABLE	
				Source of Variation		Sum of Squares	Deg. Freedom M	Mean Square
Standard Ex	Standard Error of Estimate		.0578	Linear Regression Residuals from Regression Corrected Total	gression	Í.27944 A.53463 ∯.81407	7 160 167	.18278
Multiple Co Coefficient Corrected C	Multiple Correlation Coefficient	cientninetion	.8398 .7053 .6924	F-Ratio = 54.70 Significance Le	F-Ratio = 54.70 with 7 and 160 Deg. Freedom Significance Level of F-Ratio = .0000	ø. Freedom ∅000		
o				Correction for Mean Uncorrected Total	Mean al	6.74803 8.56210	1 168	



### TABLE 6 BASIC REGRESSION STATISTICS MODEL 1FC

					Variables	Variables in the Equation	E.			
1	Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 163 · Deg. Freedom	Partial F Value with 1 and 163 Deg. Freedom	lue 163 Sig. om Level	g.
I	25 DIFF	denendent								1
,		constant	.039182	.012876	-	.232	3.04303	9.26002	.0027	327
	שביר פו	independent	047660	. 007049	.3799	.468	6.76099	45.71096	8.	0000
		independent	010089	12/100	. 2840	.407	5.69632	32.44009	8.	0000
	- F	independent	025302	. 004335	.3425	.416	5.53724	34.07334		.0000
H	2 TDF	independent	.003817	.001913	.0963	.154	1.99570	3.98280	<b>.</b>	.0476
ر ا ا سا		ı					*			
ı								•		
						ANALYSIS	analysis of va <sup>k</sup> lance summary table	ARY TABLE		
e F					Source of Variation	ation	Sum of Squares	Deg. Freedom	Mean Square	ē
29	Standard Ex	Standard Error of Estimate		.0618	Linear Regression Residuals from Regression Corrected Total	ion Regression L	1,19212 ,62195 1,81407	4 163 167	.29803	
	Multiple Co Coefficient	Multiple Correlation Coefficient	icient	.8106 .6572 5487	F-Ratio = 78.11 with 4 and 163 I Significance Level of F-Ratio =	l with 4 and loevel of F-Ration	F-Ratio = 78.11 with 4 and 163 Deg. Freedom Significance Level of F-Ratio = .0000			
	Corrected	Corrected Coefficient of Determination	erermination		Correction for Mean Uncorrected Total	Mean tal	6, 74803 8, 56210	1 168		



TABLE 7 COMPARISON OF  $\ensuremath{\text{R}}^2$  FOR MODELS 1, 1F, AND 1C

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 1	Model 1F	.0710	.0634
Model 1	Model 1FC	.1191	.1071
Model 1F	Model 1FC	.0481	.0437

<u>Model 2.</u> The data for this model (using the four digit variables) are presented in Table 8. The model yielded an  $R^2$  of .6879 and a corrected  $R^2$  of .6802. The  $R^2$  difference between Models 1 and 2 is presented in Table 9. A summary of the restricted models generated is presented in Table 62 in Appendix B.

Model 3. Cromer's process model (nine process variables) yielded an R<sup>2</sup> of .7454 and a corrected R<sup>2</sup> of .7309. A summary of the data for the model is presented in Table 10. The model thus accounted for less of the variance than did Model 1, but for more than Model 2. The factor analysis of these nine variables yielded five factors of which only four, accounting for 98.5 percent of the total factor variance, were considered. The percentage of the total factor variance and the percentage of the total variance accounted for are presented in Table 11. Table 12 presents the rotated factor matrix, which was used to see which variable correlated most highly with each factor. The variables DCM, OA, NDP, and SMD were then used to construct Model 3F. This factor model yielded an R<sup>2</sup> of .6628 and a corrected R<sup>2</sup> of .6545 and is presented in Table 13.

As with Model 1, the factoring procedure used by Cromer produced different factors from those in Model 3F. The factors he used were OM, OA, and NDP. These factors were used to produce Model 3FC, which is presented in Table 14. This model gave an  $R^2$  of .6049 and a corrected  $R^2$  of .5977.

In both cases, the factor models accounted for less of the variance than did the full model. The factors extracted in this study accounted for significantly more of the variance than did Cromer's factors. A summary of these comparisons is presented in Table 15. The restricted models generated from these three models are summarized in Tables 63, 64, and 65 in Appendix B.

Model 4. This complete flow chart model replaced the 2 Cromer variables OA and OM with the 10 new factors. In this model and in all the other complete models, TSM and TSA were not included, due to the linear dependence of the variables when the variables were included. Model 4 yielded an  $R^2$  of .7855 and a corrected  $R^2$  of .7564. These data for Model 4 are presented in Table 16. Model 4 accounted for somewhat more of the variance than did Model 1 for both the  $R^2$  and corrected  $R^2$  values.

The factor analysis of the variables in this model, omitting TSM and TSA, extracted 12 factors. Of these 12, 3 accounted for less than 1 percent of the total factor variance and were therefore not considered further. The percentage of total factor variance and the percentage of total variance for each of the remaining 9 factors are presented in Table 17. The rotated factor matrix for the 9 factors is presented in Table 18. The variables correlating most highly with each factor were chosen to represent that factor in the factor model. The variables that were used were NWA, YDM, YDA, LFS, UDS, LDF, SMD, NDP, and SDF. The model generated from these 9 variables, Model 4F, yielded an R<sup>2</sup> of .8521 and a corrected R<sup>2</sup> of .7105 (see Table 19). A summary of the comparison between Models 1, 1F, 4, and 4F is presented in Table 20. A summary of the restricted models for Model 4 is presented in Table 66 in Appendix B.



TABLE 8

## BASIC REGRESSION STATISTICS MODEL 2

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riables
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Variable	Туре	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 163 Deg. Freedom	Partial F Value with 1 and 163 Deg. Freedom	Sig. Level
25 DIFF 2 TDF 3 UDF 4 TDS 5 UDS	dependent constant independent independent independent	062142 .008252 .016824 .017945	. 015824 . 001749 . 001553 . 001565	. 2082 . 4749 . 5051		-3.92698 4.71828 10.83299 11.46772 8.92913	15.42118 22.26221 117.35358 131.50865 79,72940	. 0000

# ANALYSIS OF VARIANCE SUMMARY TABLE

Mean Square	.31198	.00347				. '
Deg. Freedom	4	163	167		1	168
Sum of Squares	1.24791	. 56617	1.81407	163 Deg. Freedom io = .0000	6.74803	8.56210
Source of Variation	Linear Regression	Residuals from Regression	Corrected Total	F-Ratio = 89.82 with 4 and 163 Deg. Freedom Significance Level of F-Ratio = .0000	Correction for Mean	Uncorrected Total
				Multiple Correlation Coefficient		

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 1	Model 2	.0884	.0756



TABLE 10

### BASIC REGRESSION STATISTICS MODEL 3

			•	Variables	Variables in the Equation			
Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 158 Deg. Freedom	Partial F Value with 1 and 158 Deg. Freedom	Sig. Level
25 DIFF	dependent							
	constant	145857	.032013		341	-4.55619	20,75884	0000.
16 OA	independent	.030855	.007989	.4177	. 294	3.86224	14.91687	.0002
17 OM	independent	020001	.007932	3986	197	-2.52155	6.35821	.0127
18 DCA	independent	024804	.012979	1732	150	-1.91105	3.65211	.0578
19 DCM	independent	.062731	.016006	. 5001	. 298	3.91930	15,36095	.0001
20 LDF	independent	.017825	.003229	. 2520	.402	5.52011	30.47165	0000.
21 SDF	independent	.015983	.004741	.2517	.259	3.37141	11.36641	6000.
22 NDP	independent	.042715	.009755	. 2669	.329	4.37896	19,17531	0000.
23 SMD	independent	043851	.011247	1637	296	-3.89908	15,20284	.0001
24 LFS	independent	.005263	.008992	.0249	.047	. 58528	.34255	.5592
						4		

# ANALYSIS OF .VARIANCE SUMMARY TABLE

Mean Square	.15024	.00292				
Deg. Freedom M	<b>o</b>	158	167	W. au.,	٦	168
Sum of Squares	1.35219	.46188	1.81407	Deg. Freedom = .0000	6.74803	8.56210
Source of Variation	Linear Regression	Residuals from Regression	Corrected Total	F-Ratio = 51.40 with 9 and 158 Deg. Freedom Significance Level of F-Ratio = .0000	Correction for Mean	Uncorrected Total
				Multiple Correlation Coefficient	:	

TABLE 11 PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 3

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	42.4	26.0
; <b>2</b>	4 (1.14 (1.15))	25.2
3	8.2	5.0
4	6.9	4.2

TABLE 12 ROTATED FACTOR MATRIX MODEL 3

				- 	٠,
Var./	Factor	1	2	3	4
1	OA	.370	.831	001	.277
2	OM	.864	.393	. 229	.029
3	DCA	.240	.817	166 es	.297
4	DCM	.909	. 243	.166	.030
5	LDF	.155	. 462	.125	083
6	SDF	. 664	.421	. 217	.238
7	NDP	.309	.551	.386	097
8	SMD	.028	.043	.070	<b>.36</b> 5
9`	LFS	.109	.006	.359	.093



TABLE 13

#### BASIC REGRESSION STATISTICS MODEL 3F

Variables in the Equation	Standardized Partial, T-Value Partial F Value Regression Correlation with 163 with 1 and 163 Sig. Coefficient Coefficient Deg. Freedom Deg. Freedom Level	
in the Equation	Partial, Correlation Coefficient	136 136 .449 .417 .365
Variables	Standardized Regression Coefficient	
	Std. Error of Regression Coefficient	. 02867 . 00692 . 00447 . 00891
	Regression Coefficient	
	Туре	dependent constant independent independent independent independent
	Variable	25 DIFF 19 DCM 16 OA 22 NDP 23 SMD

# ANALYSIS OF VARIANCE SUMMARY TABLE

Mean Square	.30058		
Deg. Freedom	163	101	1 168
Sum of Squares	1.20231	.63 Deg. Freedom	6.74803 8.56210
Source of Variation	Linear Regression Residuals from Regression	F-Ratio = 80.09 with 4 and 163 Deg. Freedom	Significance Level of F-Mati Correction for Mean Uncorrected Total
		.8141 .6628	. 6545
	Standard Error of Estimate	Multiple Correlation Coefficient	Corrected Coefficient of Determination

Ģ

TABLE 14

### BASIC REGRESSION STATISTICS MODEL 3FC

				Variables	Variables in the Equation	ď			
Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 164 Deg. Freedom	Partial F Value with 1 and 164 Deg. Freedom	lue 164 Sig. om Level	ı
25 DIFF	dependent		.03102	T 2 8 8 8 8 8 8 7	116	-1.50192	2.25576	· 	•
17 OM	independent	.01699	.00357	.3386	.349	4.76605	22.71523	0000	
16 OA	independent	.02361	. 00497	.3197	. 348	4.75291	22.5901b		
22 NDP	independent	.03894	.01025	. 2434	. 284	3.79980	14.43849	. 0000	
•			ş		ANALYSIS	ANALYSIS OF VARIANCE SUMMARY TABLE	ARY TABLE		
			٠.	Source of Variation	ıtion	Sum of Squares	Deg. Freedom	Mean Square	
				Linear Regression Residuals from Regression Corrected Total	on Regression	1.09731 71676 1.81407	3 16 <b>4</b> 167	.36577	
Multiple (Coefficien	Multiple Correlation Coefficient. Coefficient of Determination	icient	.6049	F-Ratio = 83.69 with 3 and 164 Deg. Freedom Significance Level of F-Ratio = .0000	) with 3 and 16 evel of F-Ratio	4 Deg. Freedom = .0000			
Corrected	Corrected Coefficient of Determination	ברפנווויוש רדסזו		Correction for Mean Uncorrected Total	Mean	6,74803 8,56210	1 168		

TABLE 15 COMPARISON OF  $\ensuremath{\mathsf{R}}^2$  FOR MODELS 1, 3, 3F, AND 3FC

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 1	Model 3	.0309	.0249
Model 3	Model 3F	.0826	.0764
Model 3	Model 3FC	.1449	.1332
Model 3F	Model 3FC	.0579	.0568

TABLE 16

### BASIC REGRESSION STATISTICS MODEL 4

					•	Variables	Variables in the Equation			
	Var	Variable	Туре	Regression Oxefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 147 peg. Freedom	Partial F Value with 1 and 147 Deg. Freedom	Sig. Level
ļ.	ž	DIES	denendent							
	1		constant	-,1800053	.0451931		312	-3.98302	15.86447	.0001
	٦	ORD	independent	.0001950	.0001702	. 0455	.094	1.14557	1.31233	.2538
	7	TDF	independent	.0068168	.0028727	.1720	.192	2.37297	5.63100	.0189
	٣	UDE	independent	.0118188	.0025346	.3336	.359	4.66299	21.74349	0000.
	4	TDS	independent	.0098240	.0032082	.2765	.245	3.06218	9.37696	.0026
	S	SQD	independent	.0100201	.0028751	. 2689	.276	3.48510	12.14595	9000.
	9	MON	independent	.0115299	.0105030	.1522	060	1.09777	1.20510	. 2741
	7	YDM	independent	.0247741	.0149570	.1712	.135	1.65636	2.74351	8660.
	8	NOM	independent	0114823	.0092662	2837	102	-1.23916	1.53551	. 2173
į	σ	NWM	independent	.0441503	.0259303	.3707	139	1.70265	2.89903	.0907
;	11	ğ	independent	0068228	.0157322	1103	036	43368	.18808	.6652
	12	YDA	independent	.0088103	.0133731	.0737	.054	.65881	. 43403	.5111
	13	NOA	independent	0138578	.0167358	3060	068	82803	.68563	4090
9	14	NWA	independent	9668610.	.0173346	.3165	460.	1.14797	1.31783	. 2528
<b>?</b> (	18	2	independent	.0271172	. 0403950	. 1894	.055	.67130	. 45064	. 5031
•	19	DCM	independent	. 0056492	.0251660	.0450	.019	. 22448	.05039	.8227
	50	LDF	independent	.0060261	.0045815	.0852	.108	1.31532	1.73008	.1904
	21	SDF	independent	.0073820	. 0050743	.1162	.119	1.45478	2.11637	.1479
	22	MDP	independent	0207586	. 0207686	1297	082	-, 99952	. 99904	.3192
	23	OWS	independent	0425639	.0122651	1589	275	-3.47032	12.04315	.0007
	24	LFS	independent	0012848	.0151194	0061	007	08498	.00722	.9324

# ANALYSIS OF VARIANCE SUMMARY TABLE

	. •		:	29
Mean Square	.07125			w
Deg. Freedom	26	167		1 168
Sum of Squares	1.42504	1.81407	147 Deg. Freedom io = $.0000$	6.74803 8.56210
Source of Variation	Linear Regression Residuals from Regression	Corrected Total	F-Ratio = 26.92 with 20 and 147 Deg. Freedom Significance Level of F-Ratio = .0000	Correction for Mean Uncorrected Total
		Standard Error of Estimate	Multiple Correlation Coefficient	•

TABLE 17

PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 4

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	36.6	31.3
- 2	16.0	13.7
3	14.1	12.0
4	8.5	7.3
5	8.2	7.0
6 ,	6.2	5.3
. 7	3.9	3.4
8	2.6	2.2
9	2.2	. 1.9

TABLE 18

ROTATED FACTOR MATRIX
MODEL 4

Var./	Factor	1	2	3	4	5	6	7	8	9
1	TDF	.201	088	.068	753	098	.300	<b>0</b> 99	.106	.124
2	UDF	037	.772	.118	022	027	-240	108	185	.041
3	TDS	.685	.018	029	.308	241	.352	.138	.190	. 241
4	UDS	. 270	.003	.159	.055	.806	.100	.141	012	.004
5	NDM	.814	.076	.138	.050	.420	068	144	.120	.029
6	YDM	071	.886	009	.061	127	048	.026	.202	106
7	NOM	.656	. 542	.123	.045	.361	.027	212	042	.189
8	NWM	.890	.102	.202	.107	.217	.067	212	.022	.063
9	NDA	.866	012	.330	.026	.143	.156	.103	202	125
10,	YDĀ	.222	.049	.885	.045	.010	.074	.101	<b>06</b> 9	173
11	NOA	<b>.64</b> 9	.111	.637	097	.237	.150	.132	047	.158
12	NWA	.904	017	.268	.004	.054	.166	.114	130	047
13	DCA	.268	.145	.837	168	.211	.147	.130	.140	.251
14	DCM	.455	.801	.091	.048	.277	.037	.068	021	.111
15	LDF	223	.153	.178	100	.108	.749	026	.009	.004
16	SDF	.607	-445	.171	074	.174	.091	.268	084	.282
17	NDP	.822	.061	.112	088	.018	.195	.013	.429	.011
18	SMD	018	017	.107	.034	.060	<b>00</b> 9	. 548	.003	.007
19	LFS	. 263	011	025	<b>. 7</b> 9 <b>8</b>	015	.109	.142	.074	.090

TABLE 19

### BASIC REGRESSION STATISTICS MODEL 4F

					Variables	Variables in the Equation	uc			
	Variable	Туре	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 158 Deg. Freedom	Partial F Value with 1 and 158 Deg. Freedom		Sig. Level
	25 DIPP	dependent								;
		constant	-16.2541	3.3238		363	-4.89023	23.91435	Š	0000
	14 NWA	independent	1.1477	.5437	.1823	.166	2.11091	4.45595	0.	0364
	7 YDM	independent	2.7755	.7397	.1926	. 286	3,75205	14.07785	8.	2000
	12 YDA	independent	.7375	.5960	.0614	860.	1.23749	1.53138	.21	7712
	24 LFS	independent	.6383	.9177	.0301	.055	.69554	.48377	₹.	.4877
	5 UDS	independent	.3980	.1778	.1074	.175	2,23882	5.01231	.0.	.0266
	20 LDF	independent	1.9599	.3293	.2771	.428	5.95112	35.41581	00.	000
	23 SWD	independent	-4.9882.	1.1580	1862	324	-4.30776	18.55677	00.	00
Å.	22 NDP	independent	2.3050	.9718	.1542	.185	2.37200	5.62637	.0.	.0189
· 5.	21 SDF	independent	1.9972	.4171	.3145	.356	4.78806	22.92554	0.	0000
•						O F O C F A S A S	TO THE PROPERTY OF MARIE OF	o To We you		
1						CTCTCWAY	OF VARLANCE SUPER	angut two		
9					Source of Variation	ition	Sum of Squares	Deg. Freedom	Mean Square	e .
					Linear Regression	oo	13171.82620	6	1463,53624	. 4
	Standard	Standard Error of Estimate		5.6079	Residuals from Regression	Regression	4968.88213	158	31.44862	2
	Multiple	Correlation Confe	1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	1000	77.07		60001-04-10-1	21		
	Corrected	Corrected Coefficient of Determination	onetermination	.8521 .7261 .7105	F-Ratio = 46.54 with 9 and 158 Deg. Freedom Significance Level of F-Ratio = .0000	with 9 and 19 vel of F-Ratic	58 Deg. Freedom ) = .0000			

1 168

67480.29167 85621.00000

Correction for Mean Uncorrected Total



TABLE 20 COMPARISON OF  $\ensuremath{\mathsf{R}}^2$  FOR MODELS 1, 1F, 4, AND 4F

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 1	Model 4	0116	.0001
Model 1	Model 4F	0758	.0453
Model 4	Model 4F	0666	.0006

<u>Model 5.</u> This model replaced the variables OA and OM in the set of Cromer process variables with the 10 new variables. Model 5 yielded an  $R^2$  of .7405 and a corrected  $R^2$  of .7149. The data for this model are presented in Table 21. This model accounted for less of the variance than did Model 4 and accounted for somewhat less than did Model 3.

The variables, omitting TSM and TSA, were then subjected to a factor analysis which yielded 10 factors. Of these factors, 2 were dropped from consideration since combined they accounted for .4 percent of the total factor variance. Table 22 presents the percentage of total factor variance and the percentage of total variance accounted for by the remaining 8 variables.

Table 23 presents the rotated factor matrix. This matrix was used to choose the variable that correlated most highly with each variable. These variables, NDM, YDA, YDM, LDF, SMD, LFS, NDA, and NDP, were then used to construct Model 5F. The data for the model are presented in Table 24. Model 5F yielded an R<sup>2</sup> of .6926 and a corrected R<sup>2</sup> of .6771, which accounted for less of the variation than did the full model, but which accounted for more than the Cromer process factor models (3F and 3FC). These comparisons are summarized in Table 25. A summary of the restricted models produced from these models is presented in Tables 67 and 68 in Appendix B.

<u>Model 6</u>. This model was produced using only the 10 new variables and is presented in Table 26. This model yielded an  $R^2$  of .6400 and a corrected  $R^2$  of .6219. Model 6 accounted for less of the variation than did Models 3 and 5.

The 8 variables, omitting TSM and TSA, were subjected to a factor analysis which yielded 4 factors. Table 27 gives the percentage of total factor variance and the percentage of total variance accounted for by each of these 4 factors.

Table 28 is the rotated factor matrix which was used to determine the variables that corresponded most highly with each factor. These variables, NDM, YDA, NWA, and YDM, were then used to construct the factor model. Model 6F yielded an R<sup>2</sup> of .5877 and a corrected R<sup>2</sup> of .5775. The data are presented in Table 29. Again, this factor model accounted for less of the variance than did the full model (Model 6) and also for less than the other process models (Models 3 and 5). Table 30 summarizes these comparisons. Tables 69 and 70 in Appendix B are a summary of the restricted models generated from these two models.

Model 7. This model was constructed using the 4 Cromer digit variables and the 10 new variables. Data for Model 7 are presented in Table 31. It yielded an R<sup>2</sup> of .7613 and a corrected R<sup>2</sup> of .7425. Compared with Models 1 and 4, this model accounted for less of the variance, but the difference was fairly small. The 12 variables in this model, omitting TSM and TSA, were subjected to a factor analysis which yielded 7 factors. Table 32 presents the percentage of total factor variance and the percentage of total variance accounted for by each factor. Using the rotated factor matrix found in Table 33, the variable correlating most highly with each factor was chosen to represent that factor in the factor model. The variables chosen to



## TABLE 21 BASIC REGRESSION STATISTICS MODEL 5

		on 3 di ste	·:		Variables	Variables in the Equation				
	,	**	Regression	Std. Error of Regression	Standardized Regression	Partial Correlation	T-Value with 152	Partial F Value with 1 and 152		Sig.
١	Variable	Type .	Coefficient	Coefficient	Coefficient	Coefficient	Deg. Freecom	Deg. Freedom		rever
ı	25 DIFF	dependent								
		constant	-,1862543	.0446404		-,321	-4.17232	17,40828	ō.	.0001
	WDW 9	independent	.0148649	.0103697	.1962	.115	1,43349	2.05490	7.	1538
	7 XDM	independent	.0326826	.0149858	.2259	.174	2,18091	4,75635	Ö.	.0307
	8 NOM	independent	0014088	.0096837	-,0348	012	-,14548	.02116	æ.	8845
	MMN 6	independent	.0120940	,0253626	,1016	.039	.47684	. 22738	•	6342
	11 NDA	independent	-,0089055	.0164929	-,1439	044	-,53996	, 29155	ĬŌ.	2900
	12 YDA	independent	0031587	.0140277	-,0264	018	22517	.05070	α.	8221
	13 NOA	independent	.0020054	.0173437	.0443	600.	,11563	.01337	σ.	9081
	14 NWA	independent	.0194177	.0177619	.3088	.088	1,09322	1,19513	.2	2760
	18 DCA	independent	,0129936	.0430065	.0907	.024	.30213	.09128	.7	7630
	19 DCM	independent	,0001746	.0270303	.0014	.001	.00646	.00004	6.	9949
	20 LDF	independent	.0223269	.0035578	.3157	.454	6,27549	39,38174	ō.	0000
	21 SDF	independent	.0153620	.0050308	.2419	.240	3,05359	9,32443	Ō.	0027
	22 NDP	independent	0061990	.0202757	0387	-,025	-,30574	.09347	7.	7602
	23 SMD	independent	0389648	.0129773	-,1455	-,237	-3,00254	9,01526	°.	0031
	24 LFS	independent	.0044035	.0103562	.0208	.034	.42521	.18080	9.	6713
										•
						ANALYSIS O	ANALYSIS OF VARIANCE SUMMARY TABLE	RY TABLE		
					Source of Variation		Sum of Squares	Deg. Freedom	Mean Square	re
	Standard E	Standard Error of Estimate		.0556	Linear Regression Residuals from Regression Corrected Total	on Regression	1,34334 ,47073 1,81407	15 152 167	.00310	
	Multiple C Coefficien	Multiple Correlation Coefficient Coefficient of Determination	ent	.8605 .7405 7149	F-Ratio = 28,92 Significance Le	F-Ratio = 28,92 with 15 and 152 Deg. Freedom Significance Level of F-Ratio = .0000	2 Deg. Freedom = .0000			
					Correction for Mean Uncorrected Total	Mean al	6.74803 8.56210	, 168		

TABLE 22

PROPORTION OF VARIANCE ACCOUNTED
FOR BY THE FACTORS
MODEL 5

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	43.5	35.2
2	18.5	15.0
3	15.8	12.8
4	7.2	5.8
5	4.7	3.8
6	4.1	3.3
7	2.9	2.4
8	2.9	. 2.3



TABLE 23

ROTATED FACTOR MATRIX
MODEL 5

_					-	-			p. ou		
	Var.	/Factor	1	2	3	4	5	6	7	8	
	1	NDM	.910	.169	.087	038	104	.165	127	.037	
	2	YDM	102	.008	.905	003	018	.022	.012	.128	
	3	NOM	.740	.143	.513	.153	181	.123	127	232	
	4	NWM	.884	.221	.089	.160	179	. 289	033	.015	
	5	NDA	.789	.342	058	.281	.111	.165	.340	063	
	6	YD <b>A</b>	.162	.896	.030	.090	.091	.096	.163	.024	,
	7	NOA	.668	.625	.062	.305	.192	048	005	089	
	.8	NWA	.802	. 264	062	.329	.143	.145	.339	.019	
	9	DCA	.329	.814	.112	.277	.190	181	251	.001	
	10	DCM	. 499	.107	. 786	.189	.081	.087	037	213	
	11	LDF	.200	. 213	.090	.492	033	.030	.017	.020	٠.
	12	SDF	.621	.173	.397	.239	. 298	.002	027	149	
	13	NDP	.743	.108	.091	.348	.018	.088	031	.445	
	14	SMD	040	.111	.004	016	.525	.090	.009	.003	
	15	LFS	.182	<b></b> 019	.046	.023	.105	.502	.014	.006	2 - 1/100/100 ch cm
											•

## TABLE 24 BASIC REGRESSION STATISTICS MODEL 5F

					Variables	Variables in the Equation	·	`		
<b>&gt;</b>	Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 159 Deg. Freedom	Partial F Value with 1 and 159 Deg. Freedom	llue 159 Sig. om Level	. 1
25	DIFF	dependent						1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
ì		constant	-, 268449	.037628		492	-7.13433	50.89865	0000	_
9	¥QX	independent	.020556	.005853	.2713	. 268	3.51190	12.33346	9000.	
17		independent	.002307	965900.	.0193	.028	.34979	.12235	.7270	_
7	YDW	independent	.042467	.006735	. 2935	.447	6,30563	39.76093	0000	_
20	-	independent	.024109	. 003532	.3409	.476	6.82289	46.59274	0000	_
23		independent	027921	.012169	1042	179	-2.29435	5.26402	.0231	
24		independent	.001206	.009704	.0057	.010	.12428	.01544	.9013	_
11		independent	.018612	.005393	3008	.264	3.45098	11.90929	.000	_
22		independent	.010669	.011567	.0667	.073	.92238	.85079	.3577	_
		-								
	.*					ANALYLIS	ANALYLIS OF VARIANCE SUMMARY TABLE	IRY TABLE		
		8			Source of Variation	ıtion	Sum of Squares	Deg. Freedom	Mean Square	
St	andard Er	Standard Error of Estimate		. 0592	Linear Regression Residuals from Regression Corrected Total	ion Regression	1.25641 .55766 1.81407	8 159 167	.00351	
£ 8 6	ltiple Co	Multiple Correlation Coefficient	icient	.8322 .6926 .771	F-Ratio = 44.78 with 8 and 159 Deg. Freedom Significance Level of F-Ratio = .0000	8 with 8 and 15 svel of F-Ratio	<pre>59 Deg. Freedom ) = .0000</pre>	ser F		
3 	nenseri				Correction for Mean Uncorrected Total	Mean al	6.74803 . 8.56210	1 168		
-7						•	-		-	i

ii l

TABLE 25 COMPARISON OF  $\ensuremath{\text{R}}^2$  FOR MODELS 3, 3F, 3FC, 4, 5, AND 5F  $^\circ$ 

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 3	Model 5	.0049	.0160
Model 4	Model 5	.0450	.0415
Model 5	Model 5F	.0479	.0378
Model 3F	Model 5F	0300	0226
Model 3FC	Model 5F	0857	0949



## TABLE 26 BASIC REGRESSION STATISTICS MODEL 6

						Variables	Variables in the Equation				
	Vari	Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 159 Deg. Freedom	Partial F Value with 1 and 159 Deg. Freedom	#	Sig. Level
I	25	DIFF	dependent		19991011						1 9
			constant	028092	.037017		060	75891	c8c/c.	0644	3 8
	9	NG N	independent	007109	767600.	0938	057	72560	. 52650	.4692	35
	7	YOM	independent	. 033855	.009371	.2340	. 275	3.61285	13.05267	. 0004	7
	00	NOM	independent	.008012	.004741	.1980	.133	1.68988	2.85571	0860.	ဓ္က
	o	New York	independent	.029702	.020176	. 2494	.116	1.47216	2.16724	.14:	1430
	11	NO.	independent	007123	.014551	1151	039	48954	.23965	.6251	5
**	15	XDX	independent	009197	.009488	0769	077	96927	.93948	. 3339	39
Ç	13	NOA	independent	.016229	. 005408	.3583	. 232	3.00070	9.00421	.0031	31
; }	14	NWA	independent	.017351	.013915	. 2760	860.	1.24690	1.55477	. 2143	43
			•								
50							ANALYSIS (	ANALYSIS OF VARIANCE SUMMARY TABLE	ARY TABLE		
						Source of Variation	F 196	Sum of Squares	Deg. Freedom	Mean Square	gu
	Stan Mult	idard Erro	Standard Error of Estimate	icient	.0641 .8000	Linear Regression Residuals from Regression Corrected Total F-Ratio = 35.34 with 8 an	Linear Regression 1.16109 Residuals from Regression .65298 Corrected Total 1.81407 P-Ratio = 35.34 with 8 and 159 Deg. Freedom	1.16109 .65298 1.81407 9 Deg. Freedom	8 159 167	.00411	
	8	ected On	efficient of De	Corrected Coefficient of Determination	.6219	Significance L	Significance Level of F-Ratio = .0000	0000			
						Correction for Mean	Mean	6.74803	1 2		
				-		Uncorrected Total	183	0.30210	991		
ſ											

TABLE 27

PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 6

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	49.1	41.1
2	26.3	22.0
3	13.6	11.4
4	11.0	9.2

TABLE 28

ROTATED FACTOR MATRIX
MODEL 6

Var.	/Factor	1 .	2	3	4
1	NDM	.911	.202	.137	015
2	YDM	.028	007	064	.695
3	NOM	.786	.179	.191	.453
4	NWM	.896	.271	. 263	.011
5	NDA	.612	.510	.557	157
6	YDA	.122	.798	.108	.030
7	NOA	.538	.722	269	.006
8	NWA	.598	.442	.623	156

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TABLE 29

### BASIC REGRESSION STATISTICS MODEL 6F

				Variables	Variables in the Equation	, u			
Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 163 Deg. Freedom	Partial F Value with 1 and 163 Deg. Freedom	lue .63 Sig. om Level	
25 DIFF	dependent constant	098615	.027933		267	-3.53045	12.46410		
MON 9	independent	.020692	.005509	.2731	.282	3.75625	14.10939	.0002	
12 YDA	independent	.005800	.006935	.0485	• 065	.83636	. 69949	.4042	
14 NWA	independent	.029778	.005065	.4736	.418	5.87969	34.57070	0000.	
MOX 7	independent	.049611	.007457	.3429	.462	6.65279	44.25958	0000	
				Source of Variation		ANALYSIS OF VARIANCE SUMMARY TABLE Sum of Squares Deg. Fr	KY TABLE Deg. Freedom	Mean Square	
				Linear Regression	g	1.06605	à	.26651	
Standard E	Standard Error of Estimate.		.0677	Residuals from Regression Corrected Total	Regression	.74802	163 . 167	.00459	
Multiple C Coefficien	Multiple Correlation Coefficient	icient	.7666 .5877 .5775	F-Ratio = 58.08 with 4 and 163 Deg. Freedom Significance Level of F-Ratio = .0000	with 4 and 16 vel of F-Ratio	3 Deg. Freedom = .0000			
				Correction for Mean Uncorrected Total	Mean al	6.74803 8.56210	1 168		٠,
				•					-

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TABLE 30 COMPARISON OF R<sup>2</sup> FOR MODELS 3, 3F, 3FC, 5, 5F, 6, AND 6F

Full Model	Restricted Model	R <sup>2</sup> ! Diff.	Corr. R <sup>2</sup> Diff.
Model 3	Model 6	.1054	.1090
Model 5	Model 6	.1005	.0930
Model 6	Model 6F	.0523	.0444
Model 3F	Model 6F	.0749	.0770
Model 3FC	Model 6F	.0172	.0202
Model 5F -	Model 6F	.0049	.0996



## TABLE 31 BASIC REGRESSION STATISTICS MODEL 7

td. Error of Standardized Partial T-Value Partial F Value Standardized Ocefficient Ocefficient Deg. Freedom Deg. Freedom Level Coefficient Coefficient Deg. Freedom Deg. Freedom Level Coefficient Deg. Freedom Deg. Freedom Level Coefficient Deg. Freedom Deg. Freedom Level Cool Cool Cool Cool Cool Cool Cool Co	
38536  2100  2147  2100  2148  2100  2148  210529  221529  22148  2215354  2213554  2213554  2213554  2213554  2213554  2213554  2213554  2213554  2213554  22131554  22131853  22131853  22111853  22131854  22111853  2211853  22111853  22111853  22111853  22111853  22111853  22111853  22111853  22111853  22111853  22111853  22111853  22111853  22111853  2211864  22	Std Regression Re Coefficient Co
18536360 -4.80680 23.10529 1018452100341 4.51149 20.35154 101842929348 4.51149 20.35154 102174187485 6.90902 47.77457 102182929346 4.59549 21.11853 1023732926346 4.59549 21.11853 102500157010128201647 10462011030779658593287 110591256200 2.54188 6.46118 110591256200 2.54188 6.46118 110591259140 1.76375 3.11083 1.12920516322839978 1285112920516322839978 1285112920513810415500279 1285112920113810415500279 1285213804330315500279 128534330315500279 1285444119 with 12 and 155 Deg. Freedom 128554400144303455444000444000044400004440000444000044400004440000444000044400004440000444000044400004440000444000044400000444000044400000444000004440000044400000000	dependent
021472100341 4.51149 20.35354 02147485 6.90902 47.73457 021782929358 4.77783 22.82764 021782929358 4.77783 22.82764 02373015701012832 01647 09280 0165 0167 09864 0167 09864 0167 09864 0167 09685 01647 096864 01647 096864 01647 096864 01647 096864 01647 096864 01647 09687 096864 09687 097 096886 09687 097 096886 097	constant185236
02147	independent .008324
02178 . 2929 . 358	independent .014833
023732926 .346 4.59549 21.1185302379023790164701071281201647008640107128120164700864	independent .010406
09280 .0157 .010 .12832 .01647 08664 .1061 .138 1.73219 3.00047 08664 .1061 .138 1.73219 3.00047 0946201061138 1.73219 3.00047 09462020729685 .93287 095132002002197027009 0853212581600648024664394 0531309410648024664394 0531309410648024664394 0531309410648024664394 0531309410649024664394 053130640648024664394 053130640649024664394 053130640649024664394 053130649040632289978  Source of Variation Sum of Squares Deg. Freedom Nean Squares Regression43303155 Corrected Total	. 010903
08864 .1061 .138 1.73219 3.00047 04620110307796585 .93287 19941 .4256 .200 2.54188 6.46118 130591097042 2.51970 .27009 08532 .1258 .140 1.76375 3.11083 08532 .125806480246 .64394 12851 .1292 .051 .63328 .39978  Source of Variation Sum of Squares Deg. Freedom Nean Squares Corrected Total 1.38104 12 .1555  Corrected Total 1.81407 167  F-Ratio = 41.19 with 12 and 155 Deg. Freedom Significance Level of F-Ratio = .0000  Corrected Total 6.74303 155  Corrected Total 6.74303 158  Corrected Total 6.74303 158	. 191100.
04620110307796585 .93287 .93287 .93694 .200 .200 2.54188 6.46118 .27009 .27009 .27009 .27009 .27009 .9323 .1258 .140 .176375 .931063 .932406406463228 .311063 .95313 .05106463228 .39978 .39978 .12851 .1292 .051 .63228 .39978 .39978 .12851 .1292 .051 .63228 .39978 .11509 .2864 .28640a	.015354
19941 .4256 .200 2.54188 6.46118109704251970 .27009 08532 .1258 .140 1.76375 3.11083 05313094106480246 .64394 05313094106480246 .64394 12851 .1292 .051 .63228 .39978  ANALYSIS OF VARIANCE SUMMARY TABLE  Source of Variation Sum of Squares Deg. Freedom Mean Squares treatments from Regression .43303 155 .0027  Corrected Total 1.81407 167  F-Ratio = 41.19 with 12 and 155 Deg. Freedom Significance Level of F-Ratio = .0000  Correction for Mean 6.74303 158	004463
13059109704251970 .27009 1258 .140 1.76375 3.11083 125806480246 .64394 1292 .051 .63228 .39978 12951 .1292 .051 .63228 .39978 12952 .051 ANALYSIS OF VARIANCE SUMMARY TABLE  Source of Variation Sum of Squares Deg. Freedom Mean Squ Linear Regression 1.38104 12 12077 12079 12077 12077 12077 12077 12077 12077 12077 12077 12077 12077 12077 12077 12077 12077 12077 12077 1208	.050688
08532 .1258 .140 1.76375 3.11083 05313094106480246 .64394 1292 .051 .63228 .39978 12851 .1292 .051 .63228 .39978  ANALYSIS OF VARIANCE SUMMARY TABLE  Source of Variation Sum of Squares Deg. Freedom Mean Squares from Regression 1.38104 12  Residuals from Regression 1.38104 125  Corrected Total 1.81407 167 167  F-Ratio = 41.19 with 12 and 155 Deg. Freedom Significance Level of F-Ratio = .0000  Correction for Mean 6.74303 1 168	006787
12851	.015048
ANALYSIS OF VARIANCE SUMMARY TABLE  Source of Variation Sum of Squares Deg. Freedom Mean Squ  Linear Regression 1.38104 12 .11509  Residuals from Regression .43303 155 .00279  Corrected Total 1.81407 167  F-Ratio = 41.19 with 12 and 155 Deg. Freedom Significance Level of F-Ratio = .0000  Correction for Mean 6.74303 1  Gorrection for Mean 6.74303 1  F-Ratio = 40.19 with 12 and 155 Deg. Freedom Significance Level of F-Ratio = .0000	004264
VARIANCE SUMMARY TABLE  1 of Squares Deg. Freedom 1.38104 12 2.43303 155 1.81407 167 Deg. Freedom 0000 168	independent .008125 .01
1.38104 12 1.38104 12 1.43303 155 1.81407 167 Deg. Freedom 0000 168	
Linear Regression 1.38104 12  Residuals from Regression .43303 155  Corrected Total 1.81407 167  F-Ratio = 41.19 with 12 and 155 Deg. Preedom  Significance Level of P-Ratio = .0000  Correction for Mean 6.74303 1	
F-Ratio = 41.19 with 12 and 155 Deg. Freedom Significance Level of P-Ratio = .0000 Correction for Mean 6.74303	Standard Error of Estimate
	Multiple Correlation Coefficient

TABLE 32

PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 7

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	37.6	29.0
2	20.0	15.5
3	17.1	13.2
4	16.1	12.4
5	5.4	4.2
6	2.0	1.5
7	1.8	1.4

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TABLE 33

ROTATED FACTOR MATRIX
MODEL 7

								<u> </u>	
Var.	/Factor	1	2	3	4.	5	6		
1	TDF	.095	020	.066	070	.540	.002	.007	
2	UDF	.009	.022	.109	.776	003	050	.083	
3	TDS	.767	050	.028	.020	.093	062	081	
4	UDS	.111	.768	.176	077	049	049	.046	
<b>5</b> ,	NDM	.663	.621	.134	.008	.033	.264	067	
6	MQY	006	065	032	.778	116	.051	094	
7	NOM	. 564	. 560	.081	.499	.063	.168	022	
8	NWM .	.816	.433	.213	.068	.052	.251	038	
9	NDA	.736	.336	.473	052	.136	036	.275	
10	YDA	.146	.114	.825	.071	.046	.028	.007	
11	NOA	.495	.425	.634	.103	.332	044	011	
12	NWA	.803	.258	. 394	048	.211	097	. 237	
							· <del></del>		

represent the factors were NWM, UDS, YDA, YDM, TDF, NDM, and NDA. The data for Model 7F are presented in Table 34. Model 7F yielded an  $R^2$  of .6495 and a corrected  $R^2$  of .6342. Model 7F accounted for less of the variance than did Model 7. The comparisons between the  $R^2$  for this model and the other models are summarized in Table 35. A summary of the restricted models generated from these models is found in Tables 71 and 72 in Appendix B.

Model 8. This model used the 10 new variables plus the Cromer process variables LDF, SDF, NDP, SMD, and LFS. Data for Model 8 are presented in Table 36. Model 8 had an R<sup>2</sup> value of .7404 and a corrected R<sup>2</sup> of .7184. When compared on the basis of R<sup>2</sup> to the other process models (Models 3, 5, and 6), Model 8 came out very favorably. The 13 linearly independent variables for Model 8 were subjected to a factor analysis which extracted 8 factors. Table 37 reports the percentage of total variance and the percentage of total variance accounted for by each variable.

Table 38, the rotated factor matrix, was used to determine which of the variables correlated most highly with each of the factors. These variables, NDM, YDA, YDM, LDF, SMD, LFS, NWA, and NDP, were then used to construct Model 8F. Data for Model 8F are found in Table 39. This model had an R<sup>2</sup> of .7016 and a corrected R<sup>2</sup> of .6866. Model 8F accounted for more of the variance than did the factor model of the 10 new variables (Model 6F) and the Cromer process factor model (Model 3F) and for about the same amount as Model 5F. A summary of the differences between this model and the other models is presented in Table 40. The restricted models are summarized in Tables 73 and 74 in Appendix B.

Model 9. This model contains the same 15 variables as the previous model, but has, in addition, the 4 Cromer digit variables. The data are found in Table 41 and had an R2 of .7831 and a corrected  $R^2$  of .7585. Model 9 was about the same or somewhat better than the process and digit models (1 and 7) when comparing  $R^2$  values and was also better than Model 4 when comparing corrected R2 values. These 17 variables, omitting TSM and TSA, were then subjected to a factor analysis which identified 10 factors, of which I factor was eliminated from consideration, since it accounted for .1 percent of the total factor variance. Table 42 lists the percentage of the total factor variance and the percentage of the total variance accounted for by each variable. Using the rotated factor matrix, found in Table 43, the variable corresponding most highly with each factor was then determined. These variables, NWM, YDM, LFS, YDA, UDS, LDF, SMD, NDA, and SDF, were then used to construct Model 9F. Data for Model 9F are given in Table 44. This model had an R<sup>2</sup> of .7339 and a corrected  $\mathbb{R}^2$  of .7187. The comparisons of the  $\mathbb{R}^2$  for Models 9 and 9F to the other factor models for the digit and process models are summarized in Table 45. The summary of the restricted models for both Models 9 and 9F is given in Tables 75 and 76 in Appendix B.

Model 10. This model was constructed using the 10 new variables and the Cromer process variables LDF, SDF, NDP, and LFS. Data for Model 10 are presented in Table 46. This model had an  $R^2$  of .7245 and a corrected  $R^2$  of .7032. Model 10 accounted for less of the



TABLE 34
BASIC REGRESSION STATISTICS
MODEL 7F

I						Variables	Variables in the Equation				
,	Var	Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 160 Deg. Freedom	Partial F Value with 1 and 160 Deg. Freedom	llue 160 Sig. om Level	_ 1
I	25	DIFF	dependent					73607 4	97900	0000	
		į	constant	134973	.028757	6653	348	4.69356	17.55565	0000	
	o n	MMN	independent .	622870.	005800 00500	. 2233	275	3.61177	13.04490	.0004	
	י כ	3 5	independent	.003262	006936	.0273	.037	.47033	.22121	.6388	m
	7 -	¥ C	independent	050079	.007168	.3461	.483	6.98614	48.80609	0000	_
		Ē	independent	.007743	816100.	.1954	.304	4.03635	16.29209	.000	_
ì			independent	021024	.010601	2774	155,	-1.98317	3.93295	.0491	_
<b>)</b> (	. ב	N N	independent	.011855	.006408	.1916	.145	1.85020	3.42323	.0661	_
		•									
5							ANALYSIS	ANALYSIS OF VARIANCE SUMMARY TABLE	ARY TABLE		
9					,	Source of Variation	tion	Sum of Squares	Deg. Freedom	Mean Square	
	Sta	ndard E	Standard Errör of Estimate			Linear Regression Residuals from Regression Corrected Total	on Regression	1.17825 .63582 1.81407	7 160 167	.00397	
	Mul	tiple C	Multiple Correlation Coefficient Coefficient of Determination	icient	.8059 .6495	F-Ratio = 42.36 with 7 and 160 Deg. Freedom Significance Level of F-Ratio = .0000	with 7 and 16 vel of F-Ratio	0 Deg. Freedom = .0000			
· 5	103	rected	Coffected Coefficient of Determination		1	Correction for Mean Uncorrected Total	Mean :al	6.74803 8.56210	1 168		

TABLE 35 COMPARISON OF  $\ensuremath{\text{R}}^2$  FOR MODELS 1, 1F, 1FC, 4, 6, 7, AND 7F

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R' Diff.
Model 7	Model 6	1213	1209
Model 1	Model 7	.0150	.0130
Model 4	Model 7	.0242	.0136
Model 7	Model 7F	.1118	.1086
Model 1F	Model 7F	.0558	.0582
Model 1FC	Model 7F	.0077	.0145

TABLE 36

### BASIC REGRESSION STATISTICS MODEL 8

	-		ermeter in each	Variables	Variables in the Equation	c		
	-		Std. Error of	: " Standardized	Partial	T-Value	Partial F Value	
		Regression	Regression	Regression	Correlation	with 154	with 1 and 154	:
Variable	Type	Coefficient	Coefficient	Coefficient	Coefficient	Deg. Freedom	Deg. Freedom	m Level
25 nTPF	dependent					1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
	constant	19044239	.04208805		343	-4.52486	20.47433	0000
WCIN 9	independent	.01396275	06883890	.1843	114	1.41914	2.01395	.1579
7 YDM	independent	.03125998	10093597	.2160	. 260	3,33985	11,15457	.001
8 NOM	independent	00084095	.00505017	0208	01.3	-,16652	.02773	.8680
MMN 6	independent	.01091722	01973900	.0917	.045	. 55308	30590	.5810
11 NDA	independent	-,01073812	.01479015	1735	058	72603	. 52712	. 4689
	independent	.00001426	.00862094	.0001	000.	.00165	00000	. 9987
13 NOA	independent	.00699177	.00534697	.1544	.105	1.30761	1.70986	.1930
14 NWA	independent	.01666415	.01512837	. 2650	880.	1.10152	1,21334	.2724
20 LDF	independent	.02240831	.00352428	.3168	.456	6.35827	40.42761	0000.
21 SDF	independent	.01553211	.00491732	. 2446	.247	3,15865	9.97709	.0019
22 NDP	independent	00223965	.01537274	0140	012	14569	.02123	.8844
23 SMD	independent	03859627	.01258970	1441	240	-3.06570	9,39853	
24 LFS	independent	.00411366	. 00975523	.0194	.034	.42169	.17782	.6738
			s200	•				÷÷ .
			gariae an		٠			
		•	h এ আছিল ক		ANALYSIS	ANALYSIS OF VARIANCE SUMMARY TABLE	RY TABLE	
:			idgo-igh direckiji.	Source of Variation		Sum of Squares	Deg. Freedom	Mean Square
				. Linear Regression	ion	1.34306		.10331
			3,845° i	Residuals from Regression	Regression	.47101	154	.00306
Standard 1	Standard Error of Estimate		.0553	Corrected Total	1	1.81407	167	
Multiple ( Coefficier	Multiple Correlation Coefficient	icient	.7404	F-Ratio = 33.70 Significance Lo	F-Ratio = 33.78 with 13 and 154 Deg. Freedom Significance Level of F-Ratio = .0000	54 Deg. Freedom = .0000		
***************************************	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		n. aundræ	Correction for Mean	Mean	6.74803	1,	
			nia de la companya d	Uncorrected Total	ta l	8.56210	891	
			***					



TABLE 37

PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 8

ctor mber	Percentage of Total Factor Variance	Percentage of Total Variance
	49.8	36.3
	14.3	10.5
3	10.1	7.4
4	9.9	7.2
5 .	5.5	4.0
6	5.1	3.7
7	2.7	2.0
8	2.6	1.9



TABLE 38

ROTATED FACTOR MATRIX MODEL 8

Var.	/Factor	1	2	3	4.	5	6	7	8	
1	NDM	.911	.155	031	.01.3	107	. 209	068	.107	
2	YDM	.023	014	.782	.035	.007	.018	021	.008	
3	NOM	.805	.118	.412	.174	155	.146	.011	170	
4	NWM	.862	.217	018	.212	169	.328	.021	.055	
5	NDA	.709	.410	194	.317	.104	.218	.327	.012	
6	YDA	.189	.780	.013	.177	.152	.034	.026	.016	
7	NOA	.665	.581	026	.342	.198	023	.028	022	
8	NWA	.718	.306	194	.369	.138	.199	.361	.093	
9	LDF	.193	.189	.062	<b>. 50</b> 5	025	.025	.022	.020	
10	SDF	.676	.122	.307	.265	.308	.026	.099	132	
11	NDP	.690	.076	.028	.387	.012	.151	.048	.419	
12	SMD	042	.099	002	012	.506	.084	.010	•003	
13	LFS	.166	.013	.022	.022	.095	.441	.015	.012	



TABLE 39

### BASIC REGRESSION STATISTICS MODEL 8F

					Variables	Variables in the Equation			
Vari	Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 159 Deg. Freedom	Partial F Value with 1 and 159 Deg. Freedom	Sig. Level
25	DIFF	dependent	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	9					1
		constant	-,25008418	.03788006		464	-6.60200	43.58642	0000.
9	MON	independent	.02309881	.00533357	.3048	.325	4.33084	18.75613	0000.
12	XDA	independent	.00321598	.00617629	.0269	.041	.52070	.27113	. 6033
7	XDW	independent	.04439289	.00668410	.3068	.466	6.64157	44.11039	0000.
20	LDF	independent	.02447479	.00344288	.3461	.491	7.10882	50.53530	0000.
23	SMD	independent	02826840	.01197757	1055	184	-2.36011	5.57013	.0195
24	LFS	independent	00008086	.00957811	0004	001	00844	.00007	. 9933
14	NWA	independent	.02192096	.00530165	.3406	.312	4.13475	17.09613	.0001
. 22	MDP	independent	00273262	.01247945	0171	017	21897	.04795	.8270

# ANALYSIS OF VARIANCE SUMMARY TABLE

Source of Variation Sum of Squares Deg. Freedom Mean Square	Linear Regression 1.27284 8 .15910 Residuals from Regression .54123 159 .00340 Corrected Total 1.81407 167	.8376 F-Ratio = 46.74 with 8 and 159 De .7016 Significance Level of F-Ratio = .6866	
	Standard Error of Estimate.		

TABLE 40 COMPARISON OF R<sup>2</sup> FOR MODELS 3, 3F, 3FC, 5, 5F, 6, 6F, 8, AND 8F

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 3	Model 8	.0050	.0125
Model 5	Model 8	.0001	0035
Model 6	Model 8	1004	0865
Model 8	Model 8F	.0523	.0444
Model 3F	Model 8F	0390	0321
Model 3FC	Model 8F	0967	0889
Model 5F	Model 8F	0090	0095
Model 6F	Model 8F	1139	1091



TABLE 41

### BASIC REGRESSION STATISTICS MODEL 9

	Sig. Level		0000.	.0217	0000.	.0021	-0005	.3166	.0213	.1034	.0741	.4041	.0935	.6023	.2919	.1447	. 1459	.4505	6000.	.8659
	Partial F Value with 1 and 150 Deg. Freedom		18,08568	5.38402	22,47274	9,77762	12.82697	1.00972	5.41931	2.68486	3,23508	76669.	2.84926	.27274	1,11873	2,14947	2,13705	. 57230	11.47813	.02861
٠	T-Value with 150 Deg. Freedom	1	-4.25273	2.32035	4,74054	3.12692	3.58148	1,00485	2,32794	-1.63855	1,79863	-,83664	1,68798	-,52225	1,05770	1,46611	1.46187	-,75651	-3,38794	-,16914
Variables in the Equation	Partial Correlation Coefficient		-,328	.186	. 361	. 247	.281	.082	.187	-,133	, 145	-,068	.137	-,043	980.	.119	.119	062	267	014
Variables	Standardized Regression Coefficient			.1651	,3368	.2806	.2729	.1344	.1620	-, 2084	,3214	-,1924	.1232	-,0633	. 2472	.0936	.1129	0764	-,1499	0117
	Std. Error of Regression Coefficient		.043250	.002819	.002517	,003187	.002840	.010138	. 010067	.005147	.021278	.014230	.008730	.005493	.014694	.004516	.004903	. 016157	.011356	.014655
-	Regression Coefficient		-,183932	. 006542	.011930	.009967	.01010	.010187	.023434	008433	.038272	-,011905	.014736	-,002869	.015542	.006621	.007167	012223	040167	002479
	Туре	dependent	constant	independent																
٠	Variable	25 DIFF		2 TDF	3, UDF	4 TDS	son s	WQN 9	MDX 7	B NOM	HMN 6	ADN 11	~, 12 YDA	13 NOA	14	20 LDF	21 SDF	22 NDP	23 SMD	24 LFS

# ANALYSIS OF VARIANCE SUMMARY TABLE



TABLE 42

PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 9

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	42.9	34.8
2	12.7	10.3
3	9.9	8.0
4	9.8	7.9
5	8.7	7.0
6	7.6	6.2
7	4.5	3.7
8	2.3	1.8
9	1.6	1.3

TABLE 43

ROTATED FACTOR MATRIX
MODEL 9

•					_						
	Var.	/Factor	1	2	3	4	5	6	7	8	9
	1	TDF	.221	106	749	005	116	.321	.109	108	.040
	2	UDF	.002	.805	026	.107	.023	.214	088	.160	.122
	3	1'DS	.705	029	.320	088	278	.379	.160	117	.062
	4	UDS	.294	059	.053	.109	.801	.107	.151	<b>,02</b> 3	.013
	5	NDM	.852	004	.054	.104	.398	054	-:136	108	032
	6	YDM	.015	.824	.061	036	086	050	.029	141	108
	7	NOM	.727	.461	.049	.063	.352	.036	167	059	.175
	8	NWM	.909	.029	.112	.188	.202	.083	206	043	.065
	9	NDA	.815	082	.031	.388	.139	.163	.090	.315	.036
	10	YDA	.234	.061	.004	.812	.064	.092	.134	.013	018
	11	NOA	.672	.065	112	.567	.238	.189	.180	.011	.145
	12	NWA	.860	086	.010	.303	.041	.182	.113	.307	.031
	13	LDF	.227	.153	100	.152	.118	.748	~.020	.027	.002
	14	SDF	<b>.65</b> 9	.386	072	.088	.177	.102	.302	.029	.263
	15	NDP	.858	.008	080	.046	020	.225	.048	<b>15</b> 3	236
	16	SMD	021	029	.032	.094	.059	004	.527	.003	.001
	17	LFS	.263	040	.797	018	031	.115	.144	082	.028
_											



#### TABLE 44

#### BASIC REGRESSION STATISTICS MODEL 9F

A STATE OF THE PROPERTY OF THE

		and a second			Variables	Variables in the Equation			
	Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 158 Deg. Freedom	Partial F Value with 1 and 158 Deg. Freedom	ae 8 Sig. Level
1	25 DIFF	dependent				, =			
		constant	1784991	.0322411	-	403	-5.53639	30.65157	0000.
	HMN 6	independent	.0330763	.0103117	.2777	. 247	3.20764	10.28893	.0016
	7 YDM	independent	.0286724	.0071147	. 1982	.305	4.03001	16.24095	.000
	24 LFS	independent	0005341	. 0093040	0025	005	05741	.00330	.9543
Ĭ	12 YDA	independent	.0047761	.0061327	6329	.062	. 97877.	.60651	.4373
	5 UDS	independent	.0025477	.0018000	.0684	.112	1.41537	2.00328	.1589
	20 LDF	independent	.0213456	.0032116	.3018	.467	6.64649	44.17578	0000
	23 SMD	independent	0363790	.0123142	1358	229	-2.95423	8.72749	.0036
	11 NDA	independent	.0062222	4666500.	,1006	.082	1.03714	1.07566	.3013
		independent	.0184435	.0040114	. 2904	.344	4.59781	21.13984	0000
69									¥
						ANALYSIS	ANALYSIS OF VARIANCE SUMMARY TABLE	RY TABLE	
					Source of Variation	ation	Sum of Squares	Deg. Freedom	Mean Square
		r syssadd m			Linear Regression Residuals from Regression	ion Regression	1.33129	9	.14792
-3	Standard 1	Standard Error of Estimate.	نام الله الله الله الله الله الله الله ال	.0553	Corrected Total	רו	1.81407	167	
•	Multiple ( Coefficies Porrected	Multiple Correlation Coefficient	icient	. 8567 . 7339 . 7187	F-Ratio = 48.4 Significance I	F-Ratio = 48.41 with 9 and 158 Deg. Preedom Significance Level of F-Ratio = .0000	8 Deg. Freedom = .0000		
					Correction for Mean	Mean	6.74803	٦ (	
					Uncorrected Total	tal	8.56210	168	

TABLE 45

COMPARISON OF R<sup>2</sup> FOR MODELS
1, 1F, 1FC, 4, 4F, 7, 7F, 8, 9, AND 9F

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 9	Model 8	.0427	.0401
Model 1	Model 9	0068	0027
Model 4	Model 9	.0024	0021
Mođel 7	Model 9	0218	0157
Model 9	Model 9F	.0492	.0398
Model 1F	Model 9F	0286	0243
Model 1FC	Model 9F	0767	0700
Model 4F	Model 9F	.0516	.0377
Model 7F	Model 9F	.0844	.0845

TABLE 46

#### BASIC REGRESSION STATISTICS MODEL 10

Correlation with 155 with 1 and 15 coefficient Deg. Freedom Deg. Preedom Deg. Deg. Deg. Deg. Deg. Deg. Deg. Deg.					vat tabies	אמן דמוסובא זון רווב הקתפריוסון	•		
Type   Regression   Regression   Coefficient   Coefficie		arri a <b>B</b> ell			Standardized	Partial	T-Value	Partial F Va	
Coefficient Coef			Regression	Regression	Regression	Correlation	with 155		ហ
1	Variable	Type	Coefficient	Coefficient	Coefficient	Coefficient	Deg. Freedom	Deg. Freedo	m Level
6 NDM independent 0093052 009308	1	denendent							
6 NDM         independent         .0093052         .0099808         .1228         .075         .93231         .86521           7 YDM         independent         .0091255         .0099844         .2013         .237         3.03957         9.23901           8 NDM         independent         .001654         .0051168         .0051         .005         .123729         1.5399           11 NDA         independent         .0024416         .019164         .0051         .005         .2024         .15308           12 YDA         independent         .0052023         .0054571         .1014         .005         .02400         .00589           13 NOA         independent         .0052023         .0054571         .1149         .006         .28773         .1369           14 NWA         independent         .0052023         .0036168         .3215         .451         6.28750         .0087           20 LDF         independent         .0023040         .0036168         .3215         .451         6.28750         .0378           21 NDF         independent         .001342         .0099086         .0092         .1374         .1365           22 NDF         independent         .001342         .0093 <t< td=""><td></td><td>constant</td><td> 2071055</td><td></td><td></td><td>362</td><td>-4.83311</td><td>23,35895</td><td>0000</td></t<>		constant	2071055			362	-4.83311	23,35895	0000
Name	•	independent	.0093052		.1228	. 075	.93231	.86921	.3526
NOM independent		independent	.0291295		.2013	.237	3.03957	9.23901	.0028
NRM   independent   .0194416   .019541   .2052   .099   .123729   .153699   .15369   .15369   .153699   .153699   .15369   .153699   .15369   .153699   .15369   .15369   .15369   .15369   .15369   .1	_	independent	.0016654		.0411	.026	.32547	.10593	.7453
NRA   independent		independent	.0244416		. 2052	660.	1.23729	1.53089	.2178
Yigh   independent   .0002124   .0088512   .0018   .002   .002400   .000583   .00054571   .1149   .0076   .95331   .90879   .90		independent	-,0130087		2102	069	85773	. 73569	.3924
13 NOA   Independent   .0052023   .0054571   .1149   .076   .95331   .90879     14 NWA   Independent   .0169178   .015326   .2691   .087   .108918   1.18632     15 Independent   .0123527   .0036168   .3215   .197   .250297   6.26487     15 Independent   .01023527   .0049352   .1975   .197   2.50297   6.26487     15 Independent   .0021400   .0157837   .0134   .011  1358   .01838     16 Independent   .0021400   .0157837   .0034   .011  1358   .01838     17 Independent   .0021400   .0157837   .0034   .0034  1358   .01838     18 Independent   .0019416   .0098086   .0032   .011  13758   .03918     18 Independent   .0019416   .0098086   .0092   .011  13758   .03918     18 Independent   .0019416   .0098086   .0092   .011   .13431   .12     18 Independent   .00568   .0000   .0000     18 Independent   .0000   .0000   .0000     18 Independent   .00568   .0000   .0000     18 Independent   .0000   .0000   .0000     18 Independent   .0000   .0000   .0000     18 Independent   .00000   .0000   .0000     18 Independent   .00000   .0000   .0000   .0000     18 Independent   .00000   .00000   .00000     18 Independent   .00000   .00000   .00000   .00000     18 Independent   .00000   .00000   .00000     18 Independent   .00000   .000000   .00000     18 Independent   .00000   .000000   .000000     18 Independent   .000000000   .0000000000000000000000	-	independent	.0002124		.0018	.002	.02400	85000.	6086.
NWA independent   0.0155326   0.2691   0.087   1.08918   1.18632     NWA independent   0.027495   0.0036168   0.3215   451   6.28750   39.53267     SDF independent   0.023407   0.004932   0.1945   0.1977   2.50297   6.26487     SDF independent   0.023400   0.157837   0.0134   0.011   0.1858   0.01838     AND independent   0.005400   0.0157837   0.0092   0.011   0.18758   0.01838     AND independent   0.005400   0.0157837   0.0092   0.011   0.19795   0.03918     AND independent   0.00568   0.00568   0.00568   0.0006		independent	.0052023		.1149	920.	.95331	6/806.	.3419
197   197		independent	0169178	.0155326	.2691	.087	1.08918	1,18632	.2778
SDE independent		independent	0227405	.0036168	.3215	.451	6.28750	39,53267	0000
400 .0157837		independent	0123527	.0049352	.1945	197	2.50297	6.26487	.0134
ANALYSIS OF VARIANCE SUMMARY TABLE   Source of Variation   Sum of Squares   Deg. Freedom	1 6	independent	0021400	.0157837	0134	011	13558	.01838	.8923
ANALYSIS OF VARIANCE SUMMARY TABLE Source of Variation  Linear Regression  Linear Regression  Linear Regression  1.31431  12  Residuals from Regression  249976  1.81407  1.81407  1.81407  1.87  P-Ratio = 33.97 with 12 and 155 Deg. Freedom Significance Level of F-Ratio = .0000  Correction for Mean  6.74803  168	24	independent	0019416		0092	016	19795	.03918	. 8433
ANALYSIS OF VARIANCE SUMMARY TABLE  Source of Variation Sum of Squares Deg. Freedom  Linear Regression 1.31431 12  Residuals from Regression 49976 155  Corrected Total 1.81407 167 8512 F-Ratio = 33.97 with 12 and 155 Deg. Freedom Significance Level of F-Ratio = .0000  Observation for Mean 6.74803 1				<del>ven</del> s policis					•
Linear Regression   1.31431   12   12   12   12   155   155   155   155   155   155   155   157   168   16		- 403					OF VARIANCE SUMM	RY TABLE	
Linear Regression 1.31431  Residuals from Regression .49976  Corrected Total 1.81407  1.81407		an enn			Source of Varia		Sum of Squares	Deg. Freedom	Mean Square
0568 Corrected Total 1.814078512 F-Ratio = 33.97 with 12 and 155 Deg. Freedom7245 Significance Level of F-Ratio = .00007032 Corrections for Mean 6.74803	ফ	par tur			Linear Regress	uo	1.31431	12	.10953
	Standard Erro	or of Estimate		.0568	Residuals from Corrected Total	Regression	.49976 1.81407	155 167	.00322
Correction for Mean 6.74803	Multiple Cor Coefficient	relation Coeff	icient	.8512	F-Ratio = 33.97 Significance Le	with 12 and 15 vel of F-Ratio	55 Deg. Freedom = .0000		
0.1300.0	o panario			700	Correction for Me Uncorrected Total	Mean .al	6.74803 8.56210	1 168	



variance than did the other process models (3, 5, and 8). It accounted for somewhat more of the variance than did Model 6, which consisted of only the 10 new variables.

A factor analysis was then run on these 12 variables, omitting TSM and TSA, to find a smaller set of factors that would account for approximately the same amount of the variance. Eight factors were extracted, of which 1 was eliminated from further consideration, since it accounted for only .7 percent of the total factor variance. Table 47 gives the percentage of the total factor variance and the percentage of total variance accounted for by each factor. Using the rotated factor matrix found in Table 48, the variable correlating most highly with each factor was identified, and these variables, NDM, YDA, YDM, LDF, SDF, LFS, and NDP, were used to construct Model 10F. Model 10F, the data for which appear in Table 49, had an R<sup>2</sup> value of .7101 and a corrected R<sup>2</sup> value of .6974. This model has the highest value of R<sup>2</sup> and corrected R<sup>2</sup> for all the process models considered so far. The comparisons are summarized in Table 50. A summary of the restricted models is given in Tables 77 and 78 in Appendix B.

Model 11. This model contains the same variables as Model 10 but has, in addition, the 4 Cromer digit variables. The data for Model 11 are presented in Table 51. It yielded an  $R^2$  value of .7665 and a corrected  $R^2$  of .7417. These  $R^2$  values are lower than those for the process and digit models 1, 4, and 9. The corrected  $R^2$  value is also lower than the corrected  $R^2$  of Model 7.

The 16 variables, omitting TSM and TSA, were subjected to a factor analysis which yielded 10 factors, of which one factor was dropped from consideration since, when it was combined the other factors accounted for only .0 percent of the total factor variance. Table 52 gives the percentage of factor variance and the percentage of total variance accounted for by each factor. The rotated factor matrix, given in Table 53, was then used to determine which variable correlated most highly with each factor. The variables identified were NWM, YDM, YDA, TDF, UDS, TDS, LDF, NWA, and NDP. These variables were then used to construct Model 11F, data for which are given in Table 54. This model had an R<sup>2</sup> value of .7143 and a corrected R<sup>2</sup> of .6980. These values are above the values of some of the models (Models 1F, 1FC, and 7F) and below Model 9F. These comparisons are summarized in Table 55. A summary of the restricted models for these two models is presented in Tables 79 and 80 in Appendix B.

The 24 One-Variable Models. Each of the 24 variables was used to construct a model to test the amount of the variance accounted for by that variable. The R<sup>2</sup> values ranged from .0060 for ORD to .5254 for TSM. The findings for these 24 models are summarized in Table 56. All of the factors except ORD, SMD, and LFS accounted for a significant proportion of the variance at the .01 level.

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PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 10

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	38.8	29.4
2	18.7	14.2
3	10.5	7.9
4	10.3	7.8
5	9.9	7.5
6	7.0	5.3
7	4.1	3.1
		•

TABLE 48

ROTATED FACTOR MATRIX
MODEL 10

Var.	/Factor	1	2	3	4	5	6	7	
1	NDM	.894	.189	037	.069	.113	.227	.144	
2	YDM	.028	019	.781	.035	.009	.017	.002	
3	NOM	.771	.137	<b>.3</b> 99	.212	.242	.188	104	
4	NWM	.817	.241	026	. 250	.148	.379	.105	
5	NDA	.503	<b>.4</b> 79	201	.311	.418	.313	.138	
6	YDA	.110	.809	.020	163	.053	.063	.023	
7	NOA	.522	.663	022	.330 🌣	.323	.030	.079	
8	NWA	.508	.392	201	.341	.481	.318	.252	
9	LDF	.138	.205	.061	.506	.088	.043	.048	
10	SDF	•499	.233	.307	.236	.511	.087	.034	Guera a
11	NDP	. 594	.138	.028	<b>.3</b> 99	.150	.197	.491	
12	LFS	.145	.030	.025	.028	.034	.397	.023	,
						·			



TABLE 49

#### BASIC REGRESSION STATISTICS MODEL 10F

				Variables	Variables in the Equation			
Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 160 Deg. Freedom	Partial F Value with 1 and 160 Deg. Freedom	o Sig.
25 DIFF	dependent						76604 63	
WCIN 9	onstant	254490	.035496	. 2960	493	4.29283	51.40226 18.42843	0000
AGY.	ndependent	.007947	.005504	.0665	.113	1.44383	2.08464	.1507
XDM I	ndependent	.024554	.006565	.1697	. 284	3.74010	13.98831	.0003
·	ndependent	.024655	.003370	.3486	.501	7,31635	53.52894	0000.
21 SDF	independent	.018769	.003656	. 2956	.376	. 5,13315	26.34922	0000
	Independent	.001749	.009278	.0083	.015	.18851	.03554	.8507
NDP	ndependent	.014354	.010761	.0897.	.105	1.33390	1.77930	.1841
So can sage					ANALYSIS OF	ANALYSIS OF VARIANCE SUMMARY TABLE	RY TABLE	
	<b>3</b> - 40 5 had s = -		•••	Source of Variation		Sum of Squares	Deg. Freedom	Mean Square
Standard Error of Estimate	of Estimate.		.0573	Linear Regression Residuals from Regression Corrected Total	on Regression	1.28809 .52598 1.81407	7 160 167	.18401
Multiple Correlation Coefficient  Coefficient of Determination	lation Coeffi Determination	Multiple Correlation Coefficient	.8426 .7101 .6974	F-Ratio = 55.98 Significance Le	F-Ratio = 55.98 with 7 and 160 Deg. Freedom Significance Level of F-Ratio = .0000	Deg. Freedom = .0000		
	ongo o diginal dis			Correction for Mean Uncorrected Total	Mean al	6.74803 8.56210	1	

TABLE 50

COMPARISON OF R<sup>2</sup> FOR MODELS
3, 3F, 3FC, 5, 5F, 6, 6F, 8, 8F, 10, AND 10F

Full Model	Restricted Model	R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.
Model 3	Model 10	.0209	.0277
Model 5	Model 10	.0160	.0117
Model 6	Model 10	0845	0813
Model 8	Model 10	.0159	.0152
Model 10	Model 10F	.0144	.0058
Model 3F	Model 10F	0475	0439
Model 3FC	Model 10F	1052	0997
Model 5F	Model 10F	0175	0197
Model 6F	Model 10F	1224	1199
Model 8F	Model 10F	0085	0108



TABLE 51

#### DASIC REGRESSION STATISTICS MODEL 11

		i destro est o			Variabl <b>e</b> s	Variables in the Equation	ď		٥	
	Variable	Type	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 151 Deg. Freedom	Partial F Value with 1 and 151 Deg. Freedom	.ue 51 Sig. m Level	
	25 DIFF	i dependent								
		constant	202444	.044367		348	-4.56290	20.82009	0000	
	2 TDF	independent	.005648	.002903	.1425	.156	1.94570	3.78574	.0535	
	3 UDF	independent	.012221	.002601	.3450	.357	4.69871	22.07787	0000	
	4 TDS	independent	.009641	.003295	.2714	. 232	2.92623	8.56283	.0040	
	S UDS	independent	.008830	.002908	. 2369	. 240	3.03637	9.21957	.0028	
	WCN 9	independent	.007492	. 010452	6860	. 058	.71686	.51389	.4746	
	7 YDM	independent	.018453	.010298	.1275	.144	1.79184	3.21070	.0752	
	B NOM	independent	005368	.005240	1326	083	-1.02450	1.04960	.3072	
	MMN 6	independent	.047127	.021837	.3957	.173	2.15808	4.65730	.0325	
,	11 NDA	independent	012338	.014715	1994	- 068	83847	.70304	.4031	
ý		independent	.013562	. 009021	.1134	.121	1.50336	2.26009	.1348	
۲	13. NOA	independent	003603	.005676	0796	052	63483	.40301	.5265	
<b>,</b>	14 NWA	independent	.013513	.015183	.2149	.072	89004	.79216	.3749	
7.9	20 . LDF	independent	.007736	.004658	.1094	.134	1.66091	2.75863	8860.	•
	21 SDF	independent	.004217	. 004989	.0664	690.	.84526	.71446	.3993	
	22 NDP	independent	009188	.016683	0574	045	55076	.30334	.5826	
	24 LFS	independent	009146	.015017	0432	050	60907	37096	.5434	
		of Market	- •							
		or es.				ANALYSIS	ANALYSIS OF VARIANCE SUMMARY TABLE	XY TABLE		
				181						
		1 g - 64 860			Source of Variation		Sum of Squares	Deg. Freedom	Mean Square	
					Linear Regression	ion	1.39045	16	06980.	
	Standard F	Standard Error of Estimate		.0530	Residuals from Regression Corrected Total	Regression	.42362	151	.00281	
	Multiple ( Coefficier	Multiple Correlation Coefficient	icient	.8755	F-Ratio = 30.98	F-Ratio = 30.98 with 16 and 151	, 🗅			
	Corrected	Corrected Coefficient of Determination	etermination	.7417	SIGNITICANCE TE	SIGNITICANCE PEVEL OF F-KALLO -	0000.		•	
		Printer 1			Correction for Mean	Mean	6.74803	<b>-</b> - 9		
					Uncorrected Total	tal	8.56210	168		

TABLE 52

PROPORTION OF VARIANCE ACCOUNTED FOR BY THE FACTORS MODEL 11

Factor Number	Percentage of Total Factor Variance	Percentage of Total Variance
1	37.8	31.7
2	13.0	10.9
3	12.4	10.4
4	9.9	8.3
5	7.7	6.4
6	7.6	6.3
7	7.1	6.0
8	3.1	2.6
9	1.5	1.2

TABLE 53
ROTATED FACTOR MATRIX
MODEL 11

Var.,	/Factor	1	2	3	4 ~	. 5	6	7	8	9
1	TDF	.131	094	.054	.792	052	.186	. 254	013	.013
2	UDF	.014	.809	.089	.013	.007	075	.229	.118	138
3	TDS	.532	027	.024	223	184	.631	.318	.062	.046
4	UDS	.331	070	.138	068	.784	055	.121	.022	003
5	NDM	.906	015	.121	046	.302	.042	002	~.060	.042
6	YDM ,	.018	.818	030	063	077	.050	057	124	.125
7	NOM	.770	.457	.078	038	. 287	.076	.065	025	149
8	NWM	.940	.021	.201	091	.100	.094	.140	.001	065
9	NDA	.729	087	<b>. 45</b> 9	017	.128	.142	.185	.393	023
10	YDA	.186	.058	.834	015	.058	024	.101	.011	.022
11	NOA	.576	.066	.648	.139	.274	.218	.162	.102	076
12	NWA	<b>. 73</b> 9	087	.392	.019	.058	. 242	.184	.425	.011
13,	LDF	.174	.157	.171	.139	.128	.127	.737	.038	.006
14	SDF	. 530	.386	.210	.117	.274	.407	.040	.176	156
15	NDP	. 760	.005	.131	.137	002	.351	.202	.006	<b>.31</b> 9
16	LFS	.199	048	.028	751	.007	.351	.107	024	.014

TABLE 54

#### BASIC REGRESSION STATISTICS MODEL 11F

	۶.				Variables	Variables in the Equation	u		
Variable	le	Туре	Regression Coefficient	Std. Error of Regression Coefficient	Standardized Regression Coefficient	Partial Correlation Coefficient	T-Value with 158 Deg. Freedom	Partial F Value with 1 and 158 Deg. Freedom	ue 58 Sig. n Level
25 DIFF		dependent	10501			366	-4.94079	24.41144	0000
WMN 6		constant independ <b>e</b> nt	.042302	.010540	.3552	.304	4.01358	16.10886	.0001
7 YDM	Σ:	independent	.046772	.006815	.3232	.479	6.86281	47.09810	0000.
	Æ	independ <b>e</b> nt	.005296	.006256	.0443	.067	.84659	2/10/7	98.0
2 TDF	Eu C	independent	.005054	. 002130	1275	248	3.22022	10.36984	.0016
SUD C	ט מ	independent	006234	.002538	1755	.192	2.45624	6.03309	.0151
20 1.05	) GL	independent	.016333	.003808	. 2309	.323	4.28955	18.40025	0000.
	, AT	independent	.010753	.005921	.1710	.143	1.81590	3.29749	.0713
-		independent	017465	.014028	1601	660	-1.24506	1.55018	.2150
	•	· Louis order 1861/26							
		elle sonik				ANALYSIS	ANALYSIS OF VARIANCE SUMMARY TABLE	RY TABLE	
					Source of Variation	ation	Sum of Squares	Deg. Freedom	Mean Square
Standa	rd Erro	Standard Error of Estimate		.0573	Linear Regression Residuals from Regression Corrected Total	ion Regr <b>e</b> ssion 1	1.29580 .51827 1.81407	9 158 167	.14398 .00328
	cient o	Multiple Correlation Coefficient. Coefficient of Determination	icient	.8452	F-Ratio = 43.89 Significance Le	F-Ratio = 43.89 with 9 and 158 D Significance Level of F-Ratio =	F-Ratio = 43.89 with 9 and 158 Deg. Freedom Significance Level of F-Ratio = .0000	·	
10-145-		COLLECTED COELLICIENC OL DECERMINALION.			Correction for Mean Uncorrected Total	Mean tal	6.74803 8.56210	1 168	Topics A
3		n skribe							4



TABLE 55
COMPARISON OF MODELS

					····	
Full Model		Restric Mode		R <sup>2</sup> Diff.	Corr. R <sup>2</sup> Diff.	
Model	11	Model	10	.0420	.0385	
Model	1	Model	11	.0098	.0141	
Model	4	Model	11	.0198	.0147	
Model	7	Model	11	0052	.0011	
Model	9	Model	11	.0166	.0168	
Model	11	Model	11F	.0522	.0437	
Model	1F	Model	<b>11</b> F	0090	.0056	
Model	1FC	Model	11F	0571	.0493	
Model	<b>7</b> F	Model	<b>1</b> 1F	0648	0638	
Model	9F	Model	11F	.0196	.0207	

TABLE 56
SUMMARY OF ONE-VARIABLE MODELS

Variable	$R^2$	Corrected R <sup>2</sup> .	F Ratio	đf	Significance Level	
ORD	.0060	.0000	1.00	1/166	.3198	
TDF	.0498	.0441	8.71	1/166	.0036	
UDF	.2073	.2026	43.42	1/166	.0000	
TDS	.2920	.2878	68.48	1/166	.0000	
UDS	.1513	.1462	29.59	1/166	.0000	
NDM	.3858	.3821	104.25	1/166	.0000	
YDM	.0767	.0712	13.79	1/166	.0000	
NOM	.5123	.5094	174.38	1/166	.0000	
MWM	.4841	.4810	155.77	1/166	.0000	
TSM	.5254	.5225	183.77	1/166	.0000	
NDA	.4100	.4065	115.37	1/166	.0000	
YD <b>A</b>	.1323	.1271	25.31	1/166	.0000	
NOA	.4511	.4529	139.22	1/166	.0000	
NWA	.4160	.4125	118.24	1/166	.0000	
TSA	.4715	.4683	148.07	1/166	.0000	i
OA	.4572	.4540	139.85	1/166	.0000	•
OM	.4871	.4840	157.62	1/166	.0000	
DCA	. 2647	. 2603	59.77	1/166	.0000	
DCM	.4349	.4315	127.77	1/166	.0000	,
LDF	.3125	.3084	75.46	1/166	.0000	
SDF	.4698	.4666	147.07	1/166	.0000	
NDP	,3922	.3886	107.12	1/166	.0000	,
SMD	.0090	.0030	1.51	1/166	. 2209	
LFS	.0303	.0245	5.19	1/166	.0240	

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